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Geology of the Upper Cretaceous and Tertiary Coal-Bearing Rocks in the Western Part of the Wind River Basin, Wyoming

U.S. GEOLOGICAL SURVEY BULLETIN 1813

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849

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Geology of the Upper Cretaceous and Tertiary Coal-Bearing Rocks in the Western Part of the Wind River Basin, Wyoming

By NELSON L. HICKLING, RALPH C. WARLOW,
and JOHN F. WINDOLPH, Jr.

A subsurface and surface study of **Upper**
Cretaceous and Tertiary coal-bearing
rocks with emphasis on the relation
between depositional environments and
the distribution, thickness, and
quality of coal

U.S. GEOLOGICAL SURVEY BULLETIN 1813

DEPARTMENT OF THE INTERIOR
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Geology of the Upper Cretaceous and Tertiary Coal-Bearing Rocks in the Western Part of the Wind River Basin, Wyoming

By Nelson L. Hickling, Ralph C. Warlow, *and* John F. Windolph, Jr.

Abstract

Upper Cretaceous coal-bearing rocks of the Frontier Formation in the western part of the Wind River basin record the earliest accumulation of peat in swamps overlying a system of linear shoreline and delta lobe sand bodies formed during marine regressive cycles.

The Upper Cretaceous Mesaverde Formation contains numerous coal beds that formed from peat accumulations over thick sand bodies related to distributary channels, coastal barrier bars, and prograding delta systems. Thick coal beds such as the Signor represent still-stands of long duration, and many of them contain tonsteins indicating synchronous volcanic events.

The Upper Cretaceous Meeteetse Formation contains the very thick Welton coal bed, which formed from peat accumulating in an intermontane basin. Its high silica and ash content results from rapid basin subsidence and increased influx of volcanogenic sediments.

The nearly flat-lying beds of the basal Eocene Indian Meadows Formation were deposited on an erosional surface and are unconformable with steeply dipping strata of the Mesaverde, Meeteetse, Lance, and Fort Union Formations. Early Eocene volcanic activity is recorded by numerous thin tuff beds.

INTRODUCTION

Thirty-three stratigraphic sections of coal-bearing rocks of Late Cretaceous to Tertiary age were measured in the western part of the Wind River basin (fig. 1). The study was conducted from June 1978 to August 1981 and was part of an investigation of coal beds, their extent and distribution, and their stratigraphic relations to coal-forming environments (Windolph and others, 1982). Investigations included geologic mapping, core drilling, sampling of coal beds, and establishment of stratigraphic, sedimentologic, and structural relationships.

GEOLOGIC DISCUSSION

The thickness of the composite of 33 measured sections exceeds 41,000 feet (ft). An Abney level was used to correct for dip. See table 1 for thicknesses of formations measured in sections. Locations of measured sections are shown in figure 2. Exposures of coal-bearing strata are limited to several isolated outcrops of gently dipping rocks (10°-15°) in the south and southwest and steeply dipping to overturned folded and faulted rocks in the north and northwest parts of the area.

The coal-bearing rocks studied include the following, from oldest to youngest: the Frontier Formation, Cody Shale, Mesaverde Formation, Meeteetse Formation, and Lance Formation, all of Late Cretaceous age; the Paleocene Fort Union Formation; and the lower Eocene Indian Meadows Formation. A generalized stratigraphic column for the western portion of the Wind River basin is shown in plate 1.

The oldest coal-bearing strata measured are in the upper part of the Upper Cretaceous Frontier Formation in the north and northwest parts of the study area (fig. 2, sections 22, 23, 24). These rocks record the earliest accumulation of peat in swamps overlying a system of linear shoreline and delta lobe sand bodies formed during marine regressive cycles.

Coal beds in the Frontier Formation were formed in a broad near-coastal swamp that developed on a system of prograding deltas. The Wilderness coal bed (Windolph, 1982; pl. 1) locally ranges from 12 to as much as 32 inches (in) in thickness. A near-surface sample had a calculated rank of Bituminous C, but that rank is not considered reliable.

Portions of the marine regressive Upper Cretaceous Cody Shale are described, including the chalk and tuffaceous zone at the base (section 22) and marine regressive sandstone tongues in the upper part (sections 1, 9, 11, 13, 15–18, 26).

The most important coal beds in the Mesaverde Formation, from base to top of the section, are in the Maverick Spring coal zone and include the overlying Signor, Beaver, and Shipton coal beds (pl. 1). These coals also formed from peat accumulation over thick sand bodies related to distributary channels, coastal barrier bars, and prograding delta systems (Warlow, Hickling, and Win-

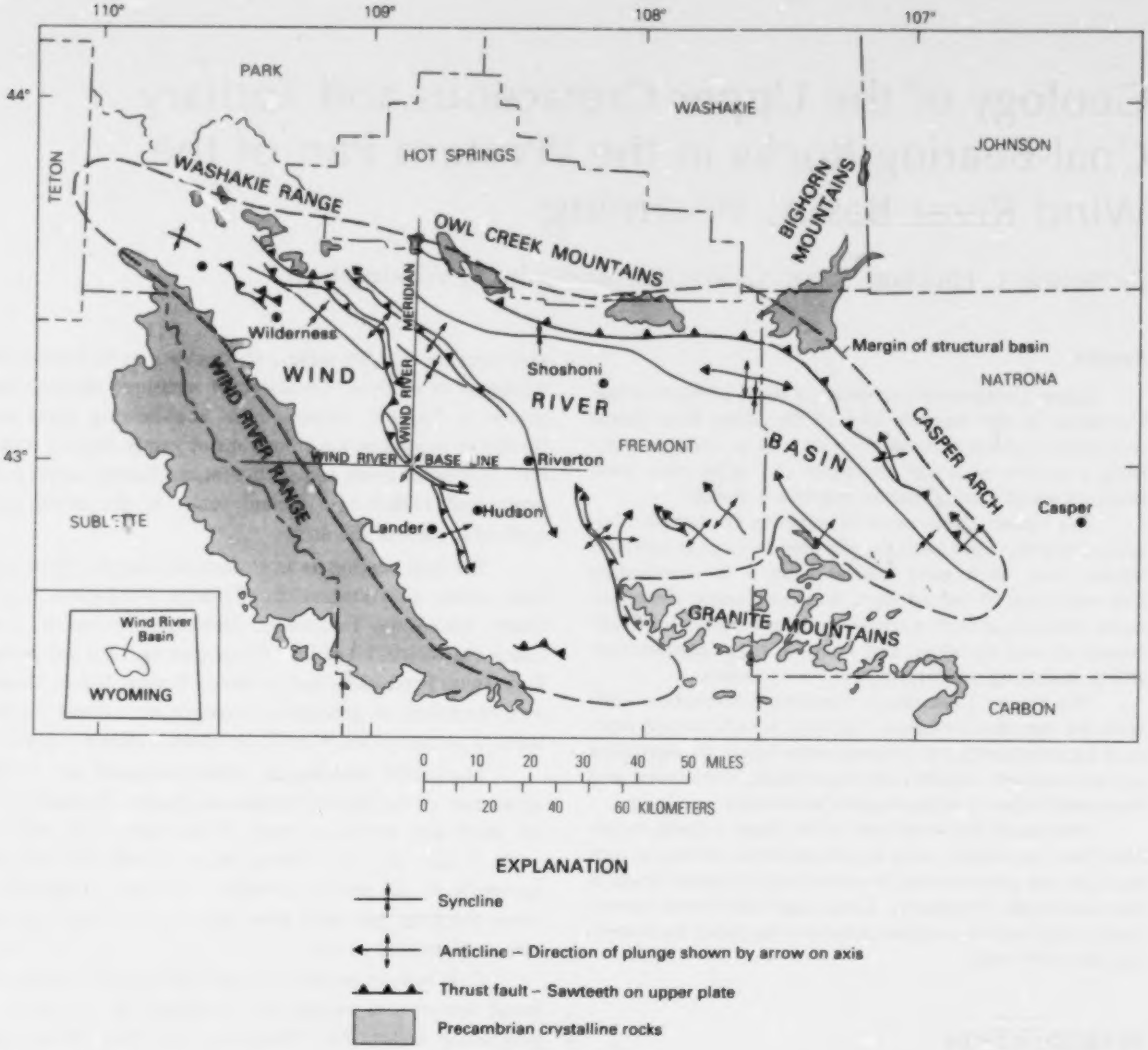
110°
109°
108°
107°
44°
43°
PARK
WASHAKIE
HOT SPRINGS
JOHNSON
TETON
WASHAKIE RANGE
OWL CREEK MOUNTAINS
BIGHORN MOUNTAINS
Wilderness
WIND
WIND RIVER MERIDIAN
Shoshoni
RIVER
Margin of structural basin
NATRONA
WIND RIVER RANGE
WIND RIVER BASE LINE
Riverton
FREMONT
BASIN
CASPER ARCH
Casper
SUBLETTE
Hudson
Lander
Wind River Basin
WYOMING
GRANITE MOUNTAINS
CARBON
0 10 20 30 40 50 MILES
0 20 40 60 KILOMETERS
EXPLANATION
Syncline
Anticline – Direction of plunge shown by arrow on axis
Thrust fault – Sawteeth on upper plate
Precambrian crystalline rocks

Figure 1. Index map of the Wind River basin.

dolph, 1986). Thick coal beds such as the Signor represent widespread stillstands of long duration. Many of these coals contain tonsteins, indicating synchronous volcanic events.

The Maverick Spring coal zone includes 2 to 10 coal beds ranging from several inches to more than 42 inches in thickness, and it has been correlated over the entire study area. Nineteen samples from the Maverick Spring coal zone showed the following calculated ranks: 11 samples, Bituminous C; 5 samples, Subbituminous A; and 3 samples, Subbituminous B (Windolph and others, 1982).

The Signor coal bed is approximately 225 ft above the Maverick Spring coal zone and ranges from 36 to 240 inches in thickness. Seven samples showed the following calculated ranks: 2 samples, Subbituminous A; 2 samples, Subbituminous B; and 3 samples, Subbituminous C. The Beaver coal bed, approximately 225 ft above the Signor, ranges from 12 to 30 inches in thickness and is not as widely distributed. A single sample of the Beaver showed a calculated rank of Subbituminous A. The Shipton coal bed, approximately 250 ft above the Beaver, ranges from 12 to 34 inches in thickness. This bed includes numerous tonsteins and silicified fossil tree stumps. Three samples of this bed had the following calculated ranks: 1 sample, Subbituminous A; and 2 samples, Subbituminous B.

Coal beds in the Frontier and Mesaverde Formations are generally low in ash content, but are slightly elevated in

Table 1. Thickness of formations measured in sections

[In feet-inches. Numbers in brackets are total formation thicknesses measured; solid lines indicate formations missing because of unconformity. Abbreviations—Upper Cretaceous: Kf, Frontier Formation; Kc, Cody Shale; Kmv, middle plus lower member of Mesaverde Formation; Kmvs, upper white sandstone member of Mesaverde Formation; Kme, Meeteetse Formation; Kl, Lance Formation. Paleocene: Tfu, lower member of Fort Union Formation; Tfus, Shotgun Member of Fort Union Formation. Lower Eocene: Tim, Indian Meadows Formation]

Section	Tim	*	Kf	Kc	Kmv	Kmvs	Kme	Kl	Tfu	Tfus	Tim
1				79–3	[1,583–2]	[189–8]	99–8				
2				50–0	[1,292–5]	[237–0]	165–0				
3							300–7	[2,272–8]	[971–6]	862–5	
4							287–2				
5				181–0	[1,955–1]	345–5					
6						349–9½	———	———	———	———	46–0
7					826–3	203–0					
8				128–10	1,363–5						
8a					141–3	123–10					
8b					78–2						
9				113–10	314–½						
10				75–0	[1,842–1]	[294–0]	11–10				
11				301–3	131–7¾						
11a					54–¾						
12										1,889–0	
13				376–5	[2,060–2½]	[206–6]	[621–8]	[762–8]	———	[810–9]	30–0
14				111–10	165–11						
15				234–6	366–4½	———	———	———	———	———	125–0
16				240–8	209–2	———	———	———	———	———	10–0
17				495–8	941–3						
17a					623–2	———	———	184–7	———	———	224–2
18				155–1	1,110–5						
19					1,571–5	50–0					
20				119–11	[1,726–0]	[346–2]	[932–3]	[164–3]	[703–9]	———	161–2
21						200–0	[944–11]	545–0			
22			151–7	74–0	———	———	———	———			
23			173–6	———	———	———	———	———	———	———	111–4
24	16–0	*	349–6	500–0							
25					694–6						
26				378–10	4–0	———	———	———	———	———	35–0
26a				574–10	417–10						
26b				50–0	622–8						
27					219–8	———	———	———	———	———	6–0
Totals	16–0		674–7	4,240–11	20,314–2	2,545–4½	3,363–1	3,929–2	1,675–3	3,562–2	748–8
Grand total			41,069–4½								

* Thrust fault places Frontier Formation on top of Indian Meadows Formation.

total sulfur content owing to their proximity to areas that underwent marginal marine depositional processes.

Section 7 includes an unusual sequence of red shale beds, conglomerate and smectitic clay, and impure coal that represents a portion of a sediment transport and depocenter that was subject to subaerial oxidation and biodegradation (Windolph, 1984).

Strata in the upper part of the Mesaverde Formation appear to have been deposited on an upper delta plain or alluvial plain, as suggested by the absence of significant coal beds, discontinuity of units, and lenticular distributary channel sandstones. Measured sections of the Mesaverde Formation range in thickness from 1,530 to 2,300 ft (sections 2, 5). The upper member of the Mesaverde Formation, the white sandstone member of Troyer and Keefer (1955), consists of a white to very light gray tabular sandstone as much as 450 ft thick. This high-energy, winnowed, marine transgressive sandstone unconformably overlies the main body of the Mesaverde Formation. The unconformity is most prominent in the northwestern part of the study area, where the Mesaverde Formation thins as much as 410 ft in a westerly direction from section 1 to section 2 to section 8 (Windolph and others, 1986).

The Meeteetse Formation of Late Cretaceous age conformably overlies the Mesaverde Formation. The Meeteetse Formation varies widely in outcrop thickness and is absent in many areas owing to erosional beveling, changes in the depositional environment, and tectonic deformation.

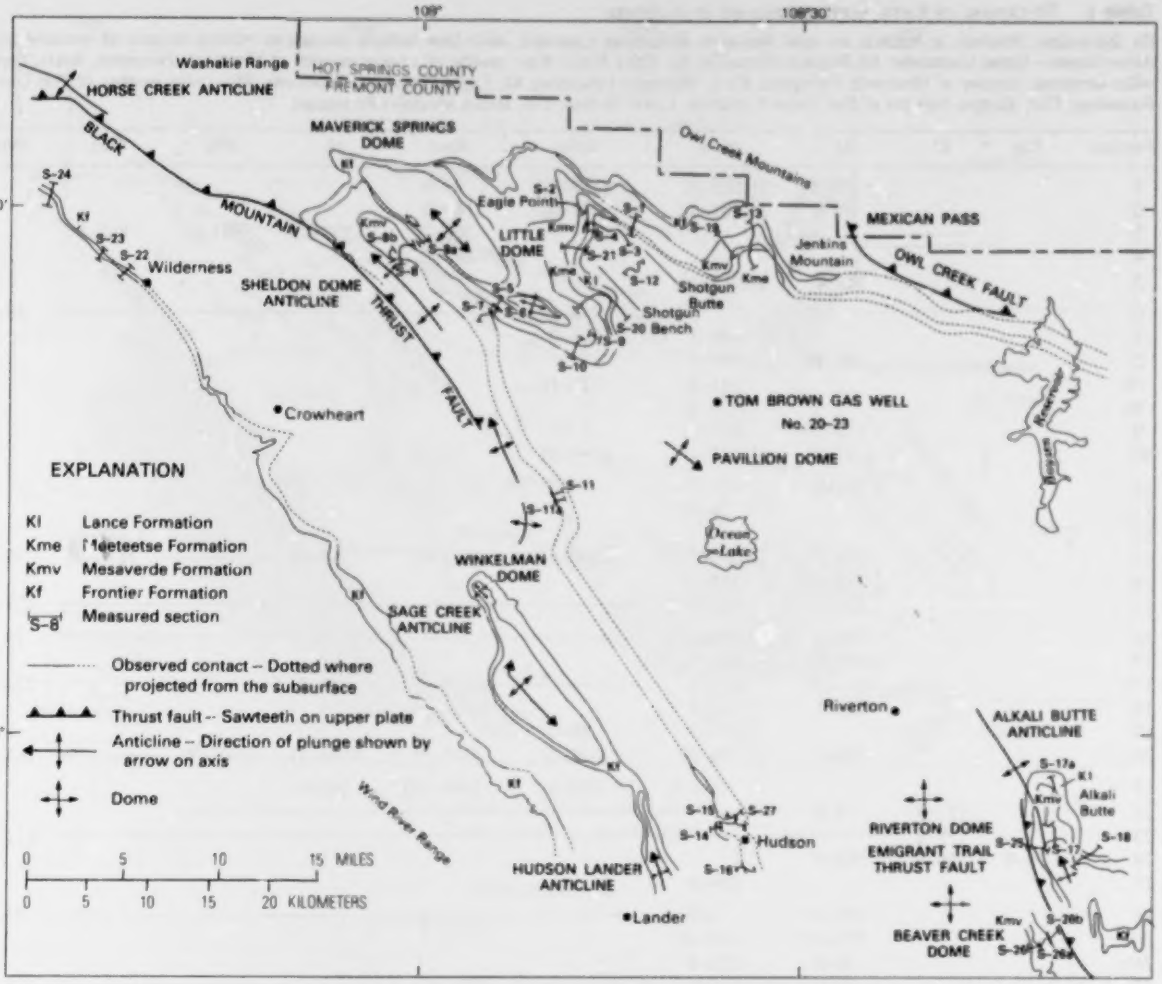
109°
108°30'
43°30'
43°
Washakie Range
HOT SPRINGS COUNTY
FREMONT COUNTY
HORSE CREEK ANTICLINE
BLACK MOUNTAIN THRUST FAULT
MAVERICK SPRINGS DOME
Owl Creek Mountains
MEXICAN PASS
OWL CREEK FAULT
Jenkins Mountain
Eagle Point
LITTLE DOME
Shotgun Butte
Shotgun Bench
SHELDON DOME ANTICLINE
Wilderness
Crowheart
TOM BROWN GAS WELL No. 20-23
PAVILLION DOME
Ocean Lake
Boysen Reservoir
WINKELMAN DOME
SAGE CREEK ANTICLINE
Riverton
ALKALI BUTTE ANTICLINE
Alkali Butte
RIVERTON DOME
EMIGRANT TRAIL THRUST FAULT
BEAVER CREEK DOME
Hudson
HUDSON LANDER ANTICLINE
Lander
Wind River Range
S-24
S-23
S-22
S-2
S-1
S-3
S-4
S-5
S-6
S-7
S-8a
S-8b
S-9
S-10
S-11
S-11a
S-12
S-13
S-14
S-15
S-16
S-17
S-17a
S-18
S-19
S-20
S-21
S-25
S-26
S-26a
S-26b
S-27
Kl
Kme
Kmv
Kf
EXPLANATION
Kl Lance Formation
Kme Meeteetse Formation
Kmv Mesaverde Formation
Kf Frontier Formation
S-8 Measured section
Observed contact – Dotted where projected from the subsurface
Thrust fault – Sawteeth on upper plate
Anticline – Direction of plunge shown by arrow on axis
Dome
0 5 10 15 MILES
0 5 10 15 20 KILOMETERS

Figure 2. Map of the western part of the Wind River basin, Wyoming, showing outcrops of the coal-bearing Upper Cretaceous Frontier, Mesaverde, Meeteetse, and Lance Formations and locations of measured stratigraphic sections. The folded structures of the area are clearly outlined by these outcrops and, for map clarity, the other formations were omitted.

Exposures of the Meeteetse Formation are thickest near Shotgun Bench, where sediments accumulated in the rapidly subsiding trough of the Shotgun Butte syncline (Warlow and others, 1988). Measured Meeteetse sections range from 0 to 944 ft in thickness and include 24 coal beds (sections 20, 21).

The Welton coal bed in the Meeteetse Formation was formed in an intermontane basin. Its higher silica and ash content is due to rapid basin subsidence and increased influx of volcanogenic sediments. Further restriction from marine influences accounts for its lower total sulfur content (Windolph and others, 1986). The Welton crops out approximately 800 ft above the base of the Meeteetse Formation and ranges from 36 to more than 120 inches in thickness. Three samples of the Welton had a calculated rank of Subbituminous A.

Section 13, near Jenkins Mountain, includes 620 ft of Meeteetse Formation and contains six coal beds. Southeast of Little Dome the Meeteetse Formation is truncated by an unconformity at the base of Eocene strata. As many as 100 coal beds have been identified from well logs in the deeper part of the basin, where the Meeteetse Formation thickens to as much as 4,500 ft and coals reach as much as 240 inches in thickness (Windolph and others, 1986).

Upper Cretaceous strata of the Lance Formation are divided here into a lower sandstone member, a middle ridge- and cliff-forming resistant sandstone member, and an upper nonresistant member. The lower member is lenticular and consists of yellowish-brown, fine- to coarse-grained sandstone units which are thick bedded to massive and locally contain high-angle crossbeds. The basal 10 ft of this member contains abundant fragments of petrified wood, dinosaur bones, and lenses of lag gravel as much as 4 in thick (sections 3, 13, 20, 21). The middle member is well exposed and consists of white to very light gray, fine- to coarse-grained sandstone with a few scattered thin medium-gray shale beds. It ranges from 100 to 900 ft in thickness.

The upper member is easily eroded, is poorly exposed, and consists of medium-gray smectitic shale which includes several impure coal beds less than 1 ft thick (section 3). This member coarsens upward to light-gray sandstone, then grades from gray to olive-gray shale and becomes less smectitic toward the top. The upper member is approximately 1,050 ft thick near Shotgun Butte (section 3). Measured thicknesses of the Lance Formation range from 0 to 2,272 ft.

The Paleocene Fort Union Formation is restricted in outcrop to the north-central part of the study area in a structural trough aligned with the Shotgun Butte and Shotgun Bench synclines (Warlow and others, 1988). Fort Union Formation thicknesses range from 0 to 1,833 ft in measured sections (section 3). Near the center of the Wind River basin, east of the study area, electric well logs indicate as much as 4,500 ft of Fort Union Formation in the subsurface. The Fort Union Formation is divided into two members: the unnamed lower member and the Shotgun Member (Keefer, 1961). The lower member consists of coarse conglomerate and sandstone which are medium gray to light yellowish brown and lenticular and contain rounded quartz pebbles, chert, and petrified wood. Sandstone units are medium light gray, fine to coarse grained, and thin to thick bedded. East of Shotgun Butte the lower member grades upward into finer grained thin-bedded sandstones and shale and wedges out entirely south of Jenkins Mountain. The basal contact of the lower member in most places is angularly unconformable with underlying strata, but locally parallel dips may be similar, making this contact difficult to locate. Most contacts are marked by a thick zone of conglomerate with dark-brown to black manganiferous and ferruginous cement and thick bands of siderite (section 3).

The Shotgun Member consists of medium-gray to light-greenish-gray shale with intervals of slightly carbonaceous bentonitic shale, several thin beds of medium-gray calcareous sandstone and siltstone, and occasional thin beds of lignite.

The nearly flat lying beds of the basal Eocene Indian Meadows Formation were deposited on an erosional surface and are unconformable with steeply dipping strata (in order of increasing age) of the Fort Union, Lance, Meeteetse, and Mesaverde Formations. Strata of the Indian Meadows Formation consisting of as much as 4,500 ft are herein divided informally into a lower and an upper member. The lower member consists of medium-gray to grayish-red to dark-reddish-brown conglomerate, arkosic sandstone, siltstone, and shale, a few thin-bedded freshwater limestone beds, and light- to medium-gray bentonitic shale beds. In the northwestern part of the Wind River basin, conglomerate beds consist of rounded boulders of Precambrian crystalline, Paleozoic, Mesozoic, and earliest Tertiary rocks, some of which exceed 15 ft in diameter (Warlow and others, 1986). Early Eocene volcanic activity is recorded by numerous thin, white to light-gray tuff beds. The westernmost tuff beds occur in the southeast corner of the Eagle Point Quadrangle near the Armstrong coal mine (Warlow and others, 1988). Two tuff beds are present near Hudson, and at least five are exposed near Alkali Butte. Thicknesses of the tuff beds range from a few inches to as much as 5 ft, and the beds generally contain fossil root impressions.

The upper member of the Indian Meadows Formation consists of distinct layers of grayish-red to variegated silty shale, smectite, and tuff; thin, dark-gray to purple, lignitic, carbonaceous shale beds; and several lenticular conglomerate beds. Only basal portions of the Indian Meadows Formation in the study area were measured.

Numerous coal beds were described in the Lance, Fort Union, and Indian Meadows Formations, but none of them reached resource thickness (30 in) in the study area.

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Measured section 1: Cody Shale through Meeteetse Formation

Location: Shotgun Butte Quadrangle, Wyoming (7.5 min)
Start: NW–NW–SE sec. 14, T. 6 N., R. 1 E. Presented from oldest to youngest
End: SW–SW–NE sec. 23, T. 6 N., R. 1 E.
Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.
Strike 270°, Dip 30° S.

	Thickness	
	Ft	in
Upper Cretaceous:		
Cody Shale:		
1. Shale, medium-gray, thin and evenly bedded, weathered	1	0
2. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, crossbedded, very calcareous, weathered	6	0
3. Shale, medium-dark-gray, thin and evenly bedded, carbonaceous; gypsum crystals on surface	13	0
4. Limestone, medium-gray, very fine grained, grading to mudstone		4
5. Shale, medium-gray to medium-dark-gray, slightly carbonaceous, few thin limestone beds ±1 in thick; few thin, very fine grained sandstone beds with crossbeds up to 6 in thick, slightly silty	17	0
6. Sandstone, medium-light-gray, very fine grained, thin-bedded, crossbedded, silty to shaly, very calcareous; few thin limestone beds, scattered weathered pyrite nodules, ¼ inch in diameter; few resistant sandstone beds ±8 in thick	14	0
7. Shale, medium-gray, silty, sandy; 1-in calcareous beds and ±1-in sandstone beds, basal 6 in medium-dark-gray, carbonaceous	3	0
8. Sandstone, medium-light-gray, very fine grained, silty; few shale interbeds	2	0
9. Shale, medium-gray, very fine grained, sandy, poorly bedded; sharp, locally slumped with convoluted bedding; calcareous beds up to 3 in thick		5
10. Sandstone, medium-light-gray, very fine to fine-grained, calcareous, massive contorted bedding, 40–45 percent quartz; light and dark mineral grains, pyrite nodules in top 1 ft, convoluted bedding fills channels in unit 9	13	0
11. Sandstone, medium-light-gray, very fine grained, thin-bedded at base, thick-bedded at top, silty to shaly, slightly carbonaceous	9	6
Total measured thickness of Cody Shale	79	3
Mesaverde Formation:		
12. Sandstone, medium-light-gray, very fine grained to medium-grained but mostly fine-grained, thick-bedded to massive, 45 percent quartz; few fractures filled with quartz, thinning to NW.; upper ±2 ft very calcareous with siderite; few crossbeds and calcareous beds 3–10 ft thick on top. Top part thin bedded with weathering cavities up to 1 ft in diameter, topset and foreset bedding, indicative of deltaic distribution	90	0
13. Siltstone, medium-gray, very fine grained, sandy, thin and evenly bedded	6	0
14. Shale, medium-gray, thin and evenly bedded	6	0
15. Shale, dark-gray to grayish-black, carbonaceous to canneloid; includes ½-in-thick coalified stem at base, gypsum crystals ±1 inch in diameter; 2 in coal 6 in below top, bright to dull with fusain, on 6 in of underclay, grayish brown to brownish black with fossil rootlets	3	0
16. Shale, medium-gray, sandy to silty, calcareous, thin and evenly bedded	3	7
17. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, dark and light mineral grains	3	6
18. Shale, grayish-brown, thin-bedded, very carbonaceous, few fossil roots and plant fragments		7
19. Shale, medium-gray to light-grayish-brown, abundance of fossil plant fragments, stems, and roots (underclay)	2	0
20. Coal, bright, few thin bony partings, resin blebs and gypsum grains weathered		10
Bottom of Maverick Spring coal zone		
21. Shale partings, light-grayish-brown with resin blebs		1
22. Coal, impure, bright, sulfur stains, resin blebs, mud balls up to 3 inches in diameter with parting	1	1
23. Shale, medium-gray, thin and evenly bedded, 2 in of limestone 1 ft below top	3	6
24. Sandstone, medium-light-gray, very fine grained, silty and shaly with pyrite nodules ½ inch in diameter	3	0
25. Shale, medium-gray, thin and evenly bedded	1	0
26. Underclay, light-grayish-brown, carbonaceous, fossil roots		3
27. Coal, impure, bony, resin blebs, gypsum crystals		1½
28. Siltstone, light-grayish-brown to medium-gray, thin and evenly bedded, silty to sandy, few coal fragments and fossil trunks ±1 inch in diameter	1	8
29. Shale, medium-dark-gray, carbonaceous, bony		1
30. Shale, medium-gray to light-grayish-brown, few fossil plant fragments and rootlets at base	1	8
31. Sandstone, medium-light-gray to medium-gray, very fine grained, silty, crossbedded, pyrite nodules and bands	6	0
32. Shale, medium-gray, thin- to poorly bedded	8	8
33. Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded	9	0

	Thickness	
	Ft	in
34. Underclay, medium-gray to light-grayish-brown, nonbedded, fossil rootlets, very carbonaceous; upper 1 in fissile, carbonaceous dark-gray shale	3	0
35. Sandstone, medium-light-gray, very fine grained, with 6-in silty shale parting in middle of unit	1	9
36. Underclay, medium-gray to light-grayish-brown, nonbedded, fossil rootlets	2	6
37. Coal, bright to dull, abundant resin blebs, some gypsum crystals, fossil plants, fine to medium cleats	1	3
38. Shale, medium-gray, carbonaceous, fossil plant fragments		2
39. Siltstone, medium-gray, interbeds of very fine grained sandstone	1	0
40. Underclay, medium-gray, nonbedded	3	0
41. Shale, carbonaceous, thin and evenly bedded, fossil plant fragments		6
42. Shale, medium-gray, thin and evenly bedded, silty	1	0
43. Sandstone, medium-light-gray, very fine grained, thin and evenly bedded, locally sideritic	1	0
44. Underclay, medium-gray, fossil rootlets	1	0
45. Shale, medium-dark-gray to dark-gray, carbonaceous		6
46. Underclay, medium-gray to light-grayish-brown, carbonaceous, fossil rootlets	1	0
47. Coal, bony		2
48. Sandstone, medium-light-gray, very fine to fine-grained, abundant large solution cavities in basal 6 ft; basal part thin bedded, crossbedded, pyrite nodules, 40–45 percent quartz, dark and light mineral grains; central part is massive; upper 6–12 ft thin bedded and very fine grained with crossbeds, few calcareous beds	32	0
49. Shale, medium-gray to medium-dark-gray, carbonaceous		6
50. Sandstone, medium-light-gray, very fine grained, siltstone laminations		6
51. Shale, medium-dark-gray, thin and evenly bedded, carbonaceous	1	0
52. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded; fossil roots in upper ±1 ft, shaly to silty, nonbedded	4	0
53. Coal, bright, weathered		2
54. Underclay, light-grayish-brown to medium-gray, fossil roots, slightly silty		7
55. Coal, weathered, bright to dull with fusain; resin, gypsum, and sulfur stains; cleats		6
56. Underclay, light-grayish-brown to medium-gray, fossil roots		7
57. Coal, dull to bright with fusain, gypsum crystals, sulfur stains, resin blebs, weathered		4½
58. Shale, medium-gray, silty, good fossil leaf impressions and stem fragments	1	0
59. Sandstone, medium-light-gray, very fine grained, silty, fossil roots and plant fragments		6
60. Underclay, medium-gray, fossil roots, silty; upper 6 in light-grayish-brown, carbonaceous	1	6
61. Coal, bright, abundant resin, gypsum, medium		8
62. Bone, with blebs of resin		3
63. Underclay, light-grayish-brown		4
64. Coal, impure		2
65. Shale (underclay), silty, fossil plant fragments and roots	1	4
66. Coal, impure		3
67. Shale, light-grayish-brown, carbonaceous, fossil plant fragments, gypsum	1	2
68. Shale, medium-gray, thin and evenly bedded, pyrite nodules, gypsum	5	6
69. Underclay, medium-gray, fossil roots, nonbedded	3	0
70. Coal, bright, banded, amber, gypsum		4
71. Shale, medium-gray to light-grayish-brown, poorly bedded, silty	1	4
72. Sandstone, medium-light-gray, very fine grained, thin-bedded, crossbedded, silty, pyrite nodules, slightly calcareous, fossil roots	1	4
73. Underclay, medium-gray, fossil roots		7
74. Shale, carbonaceous, light-grayish-brown, thin and evenly bedded, fossil plants		2
75. Shale, medium-gray, thin and evenly bedded, fossil plants		9
76. Sandstone, medium-light-gray, weathers light-gray-brown, very fine grained, calcareous, thin-bedded and crossbedded, silty; thick bedded at top. Basal part fills channels in unit 75	5	6
77. Shale, medium-gray, silty, sandy lens 6+ in thick	2	0
78. Sandstone, medium-light-gray, very fine grained, thick-bedded; few pyrite nodule bands, shale laminations; upper 3 ft thin bedded, fossil roots in upper 6 in	5	0
79. Coal, bloom		1/8
80. Underclay, medium-gray, poorly bedded, fossil roots	3	6
81. Coal, bloom, impure		3
82. Tonstein, very light grayish red to medium-pink		3
83. Coal, mostly shale, volcanic ash, or carbonaceous layers, detritus, sandstone above, irregular and channels		8
84. Sandstone, medium-light-gray, very fine to fine-grained to medium-grained, thin-bedded to massive, pyrite nodules very calcareous; 1 ft of shale chip conglomerate 5 ft above base; abundant weathering cavities	25	0
85. Underclay, medium-gray, fossil roots	3	0
86. Sandstone, medium-dark-gray, very carbonaceous, very fine grained, silty, abundance of carbonaceous material		7

	Thickness	
	Ft	in
87. Shale, medium-gray, poorly bedded	1	2
88. Sandstone, medium-light-gray, weathers yellow brown; thin bedded, very fine to fine grained, very calcareous	5	0
89. Underclay, medium-gray, fossil rootlets, pyrite nodules	11	2
90. Coal, bloom, under shale		3
Top of Maverick Spring coal zone		
91. Shale, medium-gray, weathered, thin and evenly bedded, possibly slump-bedded	1	0
92. Sandstone, medium-light-gray, fine- to medium-grained, massive, pyrite nodules 1/4 inch in diameter, crossbedded; upper half of unit thin bedded; contains few thin calcareous siltstone and sandstone interbeds; friable, fractures filled with quartz	28	0
93. Limestone, yellow-brown, weathered, brittle, very fractured, top channeled and filled by unit 94	8	0
94. Sandstone, medium-light-gray, very fine to fine-grained, massive, pyrite nodules up to 1 inch in diameter; solution cavities lens-shaped in upper 5 ft; very calcareous	9	0
95. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	10	0
96. Shale, medium-dark-gray in basal 1 ft; upper part medium gray, nonbedded	4	5
97. Siltstone, weathered yellow brown, very calcareous, brittle, broken pyrite nodules	4	0
98. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, calcareous, pyrite nodules	3	0
99. Underclay, medium-gray, fossil rootlets with coal fragments	5	0
100. Sandstone, medium-light-gray, very fine to fine-grained, calcareous, lens-shaped	2	0
101. Shale, medium-gray, silty, thin and evenly bedded; pyrite nodules and scattered bands of pyrite in central part with very fine grained sandstone, slightly carbonaceous at top	8	0
102. Sandstone, medium-light-gray to light-gray, very fine grained, silty	3	0
103. Underclay, medium-gray, nonbedded, silty, few fossil roots, 3 in of carbonaceous laminations at top	2	0
104. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, crossbedded, very calcareous; upper ±5 ft very fine grained, silty, thin bedded	11	0
105. Underclay, medium-gray, fossil rootlets	2	0
106. Coal, bloom		3
107. Shale, medium-gray, poorly bedded, few calcareous zones	9	0
108. Sandstone, medium-light-gray, very fine grained, thin-bedded, crossbedded	4	0
109. Shale (underclay), medium-gray, lower 1 in carbonaceous	4	0
110. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded to massive, few medium grains, fossil roots in upper 6 in	20	0
111. Shale, medium-dark-gray, carbonaceous, fossil plant fragments, thin and evenly bedded		2
112. Shale, medium-gray, poorly bedded	3	0
113. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	3	0
114. Shale, medium-gray, thin- to poorly bedded	1	0
115. Siltstone, dark-brown; very fine grained sandstone, very calcareous	1	0
116. Shale, medium-gray, thin and evenly bedded	10	0
117. Sandstone, medium-light-gray, weathered brown, very fine grained, thin- to thick-bedded, very calcareous	2	0
118. Shale, medium-gray, poorly bedded; upper 1 ft carbonaceous, thin and evenly bedded	9	0
119. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, very calcareous	1	0
120. Shale, medium-gray, poorly bedded	2	0
121. Sandstone, medium-light-gray, very fine grained, thin-bedded, fossil roots in upper 6 in	1	0
122. Underclay, medium-dark-gray, silty, fossil rootlets	1	5
123. Coal, bloom		1
124. Shale, medium-gray to medium-dark-gray, slightly carbonaceous, silty; upper 1 ft very fine grained sandstone, thin-bedded with pyrite nodules	4	0
125. Sandstone, medium-light-gray, very fine to medium-grained, massive, fills channels in unit 124, lens-shaped, thin-bedded, crossbedded	33	0
126. Underclay, medium-gray, fossil roots (coalified roots), 6-in-thick thin-bedded sandstone 2 ft 5 in below top; upper 4 in contains sandy detrital coal fragments	10	0
127. Sandstone, medium-light-gray, fine-grained, thick-bedded to massive, scattered pyrite nodules, solution cavities	5	0
128. Shale, medium-gray, poorly bedded, sandy	7	0
129. Sandstone, medium-light-gray, very fine grained, thin-bedded, 1/4-in-diameter pyrite nodules	1	0
130. Underclay, medium-gray, fossil roots, carbonaceous streaks	1	0
131. Coal, impure, shaly, bright bands		2
132. Underclay, medium-gray, fossil roots	2	0
133. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	0
134. Underclay, poorly bedded, silty, fossil roots; upper 6 in very carbonaceous	3	5
135. Coal, bright, gypsum grains, sparse resin blebs		5
136. Shale, light-grayish-brown, carbonaceous, abundance of bright coal streaks		

	Thickness	
	Ft	in
and fossil plant detritus		7
137. Coal, bright, gypsum grains, resin blebs		5
138. Shale, medium-gray, poorly bedded	2	5
139. Siltstone, medium-gray, very fine grained	1	2
140. Underclay, medium-gray to medium-dark-gray with carbonaceous shale, fossil roots and plant fragments	6	5
141. Coal, bright, resin, gypsum grains, closely spaced cleats		3
142. Shale, medium-gray, thin and evenly bedded; 3-in-thick calcareous siltstone in middle of unit	3	0
143. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	3	0
144. Underclay, medium-gray, poorly bedded, upper 6 in carbonaceous shale, thin and evenly bedded, fossil plant fragments	3	0
145. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded at base, thick-bedded at top with 1-ft-thick medium-gray shale, thin and evenly bedded, carbonaceous in middle of unit	6	0
146. Siltstone, medium-gray, very fine grained, sandstone	3	0
147. Shale, medium-gray, poorly bedded	3	0
148. Sandstone, medium-light-gray, very fine grained, thin-bedded	1	5
149. Underclay, medium-gray, poorly bedded, fossil roots	2	0
150. Coal, bright, weathered		2
151. Shale, medium-gray, poorly bedded	2	0
152. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	6
153. Shale, medium-gray, poorly bedded	1	8
154. Sandstone, medium-light-gray, weathered light-brown, very fine grained, thin-bedded, silty, very calcareous	2	0
155. Shale, medium-gray, poorly bedded	2	0
156. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty		4
157. Shale, medium-gray, poorly bedded	1	0
158. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, lens-shaped	1	0
159. Shale, medium-gray, thin and evenly bedded	2	2
160. Sandstone, medium-light-gray, very fine grained, silty, calcareous		5
161. Shale, medium-gray, poorly bedded	1	5
162. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, calcareous	1	7
163. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, top 6 in very carbonaceous	1	5
164. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded	5	0
165. Shale, medium-gray, poorly bedded	9	0
166. Sandstone, medium-light-gray, weathered brown, very fine grained, silty, very calcareous	11	0
167. Shale, medium-gray, poorly bedded	8	0
168. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	3	0
169. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, carbonaceous in upper 1 ft	3	5
170. Sandstone, medium-light-gray, very fine to fine-grained, thin and irregularly bedded with shale chip conglomerate	7	0
171. Shale, medium-gray, thin and evenly bedded	2	0
172. Underclay, silty, sandy, fossil roots	3	0
173. Shale, medium-gray, thin and evenly bedded	2	6
174. Siltstone, medium-gray, thin and evenly bedded, very calcareous		9
175. Shale, medium-gray, thin and evenly bedded; basal 2 in very carbonaceous, fossil plant fragments	1	8
176. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	3	0
177. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, fossil plant fragments	5	0
178. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, pyrite nodules ¾ inch in diameter		8
179. Shale, medium-gray to medium-dark-gray, very carbonaceous in basal 1 ft and top 1 ft, slightly silty in central part	4	0
180. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, ironstone band at base		11
181. Shale, medium-dark-gray, thin and evenly bedded, very carbonaceous		7
182. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty		5
183. Underclay, medium-gray, fossil rootlets	1	6
184. Coal, impure, shaly		2
185. Shale, medium-gray, thin and evenly bedded, fossil plants	1	2
186. Sandstone, medium-light-gray, fine- to medium-grained, pyrite nodules 1 inch in diameter, crossbedded, thin and irregularly bedded, shale chips and siltstone fragments up to 5 inches in diameter, solution cavities	17	0
187. Siltstone, medium-gray, very fine grained, thin-bedded, sandstone	5	0
188. Sandstone, medium-light-gray, very fine grained, crossbedded, thin-bedded, silty	1	4
189. Shale, medium-gray, thin-bedded, very silty, upper part graded	4	0
190. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, ripple bedding, mica flakes; basal half of unit friable, upper part very calcareous, sparse pyrite nodules	2	0
191. Siltstone, medium-gray, very fine grained, sandy	1	0
192. Shale, medium-gray, thin and evenly bedded, slightly fissile	8	0
193. Siltstone, medium-gray, thin-bedded, pyrite nodules, very calcareous, brittle		

		Thickness	
		Ft	in
	fracture		5
194.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, grades upward; 1-in coal fragments 7 in above base, very friable in basal 6 in, crossbedded, thin and evenly bedded, top 2 ft channeled; shale chips in basal ±2 ft, solution cavities, fine- to medium-grained where massive	12	3
195.	Shale, medium-dark-gray, thin and evenly bedded, very carbonaceous	2	6
196.	Siltstone, medium-gray, very fine grained sandstone, very calcareous	3	4
197.	Shale, medium-gray, thin and evenly bedded; upper 6 in slightly carbonaceous	3	0
198.	Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thin- to thick-bedded, crossbedded, carbonaceous fragments, friable, top ±1 ft; scattered pyrite nodules 1½ inches in diameter, base undulates, sparse mica flakes; 1-ft-thick medium-gray shale lens with 4-in-diameter pyrite nodules, 1 ft below top; upper 1 ft very calcareous	12	3
199.	Shale, medium-dark-gray, slightly carbonaceous at base	1	9
200.	Siltstone and very fine grained sandstone, medium-gray	3	0
201.	Underclay, poorly bedded to nonbedded, fossil roots, upper 1 ft medium-dark-gray carbonaceous shale	3	0
202.	Sandstone, medium-light-gray, very fine grained, thin-bedded, dark and light mineral grains, sparse mica flakes, pyrite nodules		7
203.	Sandstone, medium-light-gray, very fine grained, crossbedded, ¼-in pyrite nodules		6
204.	Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	5
205.	Underclay, medium-gray, nonbedded, silty, fossil rootlets	2	6
206.	Coal, impure, weathered		1
207.	Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	2
208.	Shale, light-brownish-gray, carbonaceous, fossil plant fragments	2	1
209.	Coal, bright, abundance of resin blebs		4
210.	Bone, shaly		5
211.	Shale, medium-gray to medium-dark-gray, carbonaceous in places; 4-in-thick ironstone band 4 ft above base, 2-in-thick ironstone bands 1 ft and 3 in below top; top contact sharp and undulating, base channeled	9	2
212.	Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, massive at base, crossbedded, pyrite nodules, thin-bedded at top, solution cavities	15	8
213.	Shale, medium-dark-gray, thin and evenly bedded, carbonaceous fossil plant fragments	3	0
214.	Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to massive, crossbedded, solution cavities, pyrite nodules	6	0
215.	Shale, medium-gray, thin and evenly bedded	14	0
216.	Underclay, medium-gray, nonbedded, fossil rootlets	1	4
217.	Shale, medium-dark-gray, thin and evenly bedded, carbonaceous, coaly, fossil plant material		6½
218.	Shale, medium-gray, thin and evenly bedded	5	2
219.	Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thin-bedded, solution cavities, fractures filled with quartz, few scattered pyrite nodules ±¼ inch in diameter; 22-in silty lens 8 ft above base, crossbedded, ripple beds, top ±2 ft very calcareous with 4-in-thick calcareous siltstone 2 ft below top of unit	50	0
220.	Sandstone, medium-light-gray, very fine grained, silty with shale laminations, thin-bedded, friable, dark and light mineral grains, micaceous solution cavities, carbonaceous laminations, crossbedded	4	0
221.	Underclay, medium-gray, nonbedded, fossil roots, shaly	15	0
222.	Coal, impure, shaly		4
223.	Shale, medium-dark-gray, thin and evenly bedded, carbonaceous, gypsum	2	2
224.	Limestone, light-gray, very fine grained, very silty		10
225.	Shale, medium-gray, thin- to poorly bedded	5	4
226.	Sandstone, medium-light-gray, very fine grained, silty, sparse mica, dark and light mineral grains, thin- to irregularly bedded, iron-stained	2	4
227.	Underclay, medium-gray, nonbedded, shaly, 1-ft-thick calcareous zone 1 ft above base, fossil roots, upper 4 in thin and evenly bedded, carbonaceous shale, medium-dark-gray	10	0
228.	Sandstone, medium-light-gray, very fine to fine-grained, silty, dark and light mineral grains, thick-bedded; basal ±2 ft thin bedded, very calcareous, brown-	8	6
229.	Shale, medium-dark-gray, silty, carbonaceous, fossil plant fragments and coaly laminations, top grades upward into unit 230		8
230.	Sandstone, medium-light-gray, very fine grained, slightly silty with pyrite nodules, thin- to thick-bedded; irregularly bedded 6-in-thick shale lens 2 ft below top, top thin bedded, very calcareous	15	0
231.	Underclay, medium-gray to medium-dark-gray, fossil rootlets, very carbonaceous, coal laminations, silty	4	2

	Thickness	
	Ft	in
232. Sandstone, medium-light-gray, weathered light gray, very fine grained	1	4
233. Shale, medium-gray, poorly bedded	1	10
234. Sandstone, medium-light-gray, very fine grained, crossbedded, dark and light mineral grains, very calcareous, thin and irregularly bedded	2	0
235. Shale, medium-gray, thin- to poorly bedded, top grades into unit 236	5	0
236. Sandstone, medium-light-gray, very fine grained, silty, dark and light mineral grains, thin and irregularly bedded	1	4
237. Sandstone, medium-light-gray, very fine grained, pyrite nodules crossbedded, shaly at base, very calcareous	10	0
238. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, silty, thin-bedded	4	0
239. Shale, medium-dark-gray, carbonaceous, fossil plant material	1	0
240. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	2	2
241. Shale, medium-gray to medium-dark-gray, carbonaceous in upper 2 ft	4	10
242. Sandstone, medium-light-gray, very fine to fine-grained, dark and light grains, pyrite nodules, thin-bedded, crossbedded, solution cavities	2	3
243. Shale, medium-dark-gray, carbonaceous, thin and evenly bedded, fossil plant fragments	3	0
244. Siltstone, medium-gray, thin-bedded, very fine grained sandstone	1	0
245. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, fossil plant fragments	3	0
246. Limestone, medium-gray, silty, brittle	1	6
247. Shale, medium-dark-gray, carbonaceous, medium-gray, top grades into unit 248	2	0
248. Sandstone, medium-light-gray, very fine grained, very silty, thin-bedded, solution cavities	1	2
249. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	2	0
250. Sandstone, medium-light-gray, very fine grained, silty, dark and light mineral grains, sparse mica, thin-bedded, pyrite nodules	1	1
251. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	1	3
252. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, very calcareous		9
253. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, fossil plant fragments	4	0
254. Limestone, medium-gray, silty, brittle	1	10
255. Shale, medium-dark-gray, gypsum, coaly	7	0
256. Sandstone, medium-light-gray, very fine grained, very silty, thin and irregularly bedded	1	9
257. Shale, medium-dark-gray, thin and evenly bedded, carbonaceous, fossil plant fragments, top sharp	2	0
258. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded; contains 4-in-thick shale lens 8 in below top, medium dark gray, carbonaceous, top sharp	2	10
259. Shale, medium-dark-gray to medium-gray, slightly carbonaceous, thin and evenly bedded	6	0
260. Siltstone, medium-gray, very fine grained sandstone, calcareous	1	8
261. Underclay, medium-dark-gray, carbonaceous with coal lamination and fragments, fossil roots	3	0
262. Coal, bright, abundance of resin blebs, gypsum crystals		4
263. Siltstone, medium-gray, thin and evenly bedded		6
264. Sandstone, medium-light-gray, very fine grained, very silty, thin and irregularly bedded	3	8
265. Shale, medium-gray, slightly carbonaceous, thin and evenly bedded	2	0
266. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, silty, thin-bedded, mica	1	2
267. Underclay, medium-gray, fossil rootlets	1	6
268. Coal, impure		2
269. Shale, medium-gray to medium-dark-gray, basal 6 in very carbonaceous with coal laminations	3	5
270. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, mica	1	10
271. Shale, medium-gray, thin and evenly bedded, pyrite nodules, top sharp	12	0
272. Sandstone, medium-light-gray, very fine to fine-grained, massive, pyrite nodules, very calcareous, solution cavities, mica	4	0
273. Shale, medium-dark-gray, thin and evenly bedded, silty, carbonaceous; at top coal and fossil plant fragments	1	8
274. Sandstone, medium-light-gray, very fine grained, silty, dark and light mineral grains, thin-bedded, crossbedded, irregularly bedded	9	0
275. Underclay, medium-gray, fossil rootlets		3
276. Coal, impure		½
277. Shale, medium-gray to medium-dark-gray, carbonaceous	3	6
278. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	6
279. Bentonite, light-olive-gray, gypsum, bright	2	0
280. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	2	3
281. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	0
282. Shale, medium-dark-gray, thin and evenly bedded, very carbonaceous, fossil roots, coal fragments	1	10

		Thickness	
		Ft	in
283.	Coal, bright to dull		2
284.	Shale, medium-gray, thin and evenly bedded	5	0
285.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, iron-stained	3	1
286.	Shale, medium-gray, thin and evenly bedded	2	6
287.	Sandstone, medium-light-gray, weathered brown, very calcareous, very fine grained	6	0
288.	Shale, medium-gray, thin and evenly bedded, slightly carbonaceous, pyrite nodules	4	0
289.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	8	6
290.	Shale, medium-dark-gray to medium-gray, carbonaceous, fossil plant fragments	6	8
291.	Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded	1	4
292.	Shale, medium-dark-gray to medium-gray, carbonaceous	1	2
293.	Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded, pyrite nodules to 1/4 inch in diameter	1	3
294.	Shale, medium-dark-gray to medium-gray, thin and evenly bedded; lower ±1 ft carbonaceous	2	9
295.	Siltstone, medium-gray, very fine grained sandstone, silty		3
296.	Shale, medium-gray; 4-in-thick ironstone band 3 ft below top	5	10
297.	Sandstone, medium-light-gray, very fine grained, silty, pyrite nodules, thin- to thick-bedded, very calcareous	3	0
298.	Underclay, medium-light-gray, fossil roots, shaly at base, silty	2	6
299.	Siltstone, medium-gray, sparse fossil plant stems	1	6
300.	Shale, carbonaceous, very silty, some pyrite nodules, scattered fossil plants		4
301.	Siltstone, medium-gray, top grades into unit 302, fossil plant fragments	2	2
302.	Shale, medium-gray, fair fissility	1	6
303.	Underclay, medium-gray, fossil plants	2	6
304.	Shale, medium-dark-gray, carbonaceous in basal 2 in, scattered carbonaceous zones	1	10
305.	Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, silty, slightly calcareous, thin and irregularly bedded	2	0
306.	Shale, medium-gray, fossil plant fragments		6
307.	Siltstone, medium-light-gray, iron-stained in lower half, scattered fossil plants	1	8
308.	Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, iron-stained, thin-bedded, crossbedded	3	6
309.	Shale, medium-light-gray, 6-in-thick siltstone band 2 ft above base, top grades into unit 310	5	9
310.	Underclay, medium-gray, silty, fossil roots	1	0
311.	Shale, carbonaceous, fossil plant fragments		4
312.	Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thick- to thin-bedded, solution cavities, pyrite nodules, crossbedded; 2-ft-thick shale lens 2 ft above base grades laterally	25	0
313.	Underclay, medium-gray, sandy in basal 1 ft, fossil roots, very silty	2	0
314.	Shale, carbonaceous, fossil plant and coal fragments		5
315.	Shale, dark-gray to black, very carbonaceous, scattered coal fragments and resin		6
316.	Shale, carbonaceous, dark-gray, fossil plants		3
317.	Sandstone, light-gray, very fine grained, thin and irregularly bedded, calcareous band at middle, top grades into unit 318	1	8
318.	Shale, medium-gray		6
319.	Underclay, light- to medium-gray, hard, silty and sandy, scattered carbonaceous fragments, fossil roots	1	6
320.	Shale, dark-gray, carbonaceous coal fragments, fossil plants	2	3
321.	Underclay, medium-light-gray, silty, hard, fossil roots, very sandy in top 1 ft 2 in	2	0
322.	Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, thick-bedded, solution cavities, pyrite nodules	1	6
323.	Underclay, medium-dark-gray, fossil roots and plant fragments	1	6
324.	Shale, medium-gray, carbonaceous bands in basal 1 ft 4 in	2	6
325.	Sandstone, very fine-grained, silty, thin and irregularly bedded, scattered fossil plants	1	6
326.	Shale, medium-gray	1	6
327.	Siltstone, medium-gray, fossil plant fragments	2	0
328.	Shale, light- to medium-gray, sandstone lens 1½ ft above base, 4 in thick	5	0
329.	Sandstone, medium-light-gray, very fine to fine-grained, mostly fine-grained, light and dark mineral grains, silty, thin- to thick-bedded, crossbedded, fossil plant fragments, solution cavities, pyrite nodules; 2-in-thick shale lens 2 ft above base; base sharp; iron stained in top half of unit	8	0
330.	Underclay, medium-gray	2	0
331.	Shale, medium-gray, carbonaceous laminations and coal fragments in top	1	6
332.	Sandstone, very fine to fine-grained, mostly fine-grained, dark and light		

		Thickness	
		Ft	in
	mineral grains, thin-bedded, slightly silty	1	0
333.	Shale, carbonaceous, silty		10
334.	Sandstone, very fine to fine-grained, mostly fine-grained, dark and light mineral grains, silty, thin-bedded, nonresistant	4	8
335.	Shale, medium-dark-gray, carbonaceous, fossil plants	1	0
336.	Sandstone, very fine to fine-grained, mostly fine-grained, nonresistant	1	4
337.	Shale, medium-dark-gray, carbonaceous	6	0
338.	Sandstone, medium-light-gray, very fine to medium- grained, mostly fine-grained, thick-bedded to massive, pyrite nodules, solution cavities, coarsens to medium-grained upward, 1-ft-8-in-thick shale lens 2½ ft below top; abundant shale chips in basal 2 ft	20	0
339.	Shale, medium-gray, very carbonaceous, coal fragments and laminations in top 6 in	2	0
340.	Siltstone, medium-gray, thin-bedded, calcareous in top 1 ft	4	0
341.	Sandstone, very fine to fine-grained, mostly fine-grained, light and dark mineral grains, thin and irregularly bedded	4	0
342.	Shale, medium-gray, fossil plants in basal portion	10	6
343.	Sandstone, medium-light-gray, very fine to fine-grained, pyrite nodules	20	0
344.	Shale, medium-gray	1	0
345.	Siltstone, medium-gray, thin-bedded	2	0
346.	Shale, medium-light-gray, 2-in-thick carbonaceous zone 1 ft 4 in above base, silty	2	6
347.	Siltstone, medium-light-gray, thin-bedded	1	2
348.	Shale, medium-gray, carbonaceous laminations in upper 1 ft	1	8
349.	Siltstone, medium-gray, thin-bedded		4
350.	Underclay, medium-gray, fossil plant fragments, silty at top	1	4
351.	Siltstone, medium-light-gray, sandy, thin and irregularly bedded	3	0
352.	Shale, light- to medium-gray, fossil plants	2	0
353.	Underclay, fossil plants		7
354.	Shale, very carbonaceous, abundant coal laminations and fragments		4
355.	Shale, light- to medium-gray, fossil plants		3
356.	Sandstone, medium-gray, very fine to fine-grained, thin-bedded, solution cavities, pyrite nodules	1	0
357.	Underclay, medium-gray, silty in lower two-thirds of unit, fossil roots and plants, gypsum	6	0
358.	Shale, dark-gray, gypsum, carbonaceous		6
359.	Shale, medium-gray, thin and evenly bedded	1	0
360.	Siltstone, medium-gray, thin and irregularly bedded		4
361.	Sandstone, medium-gray, very fine grained, very silty, irregularly bedded	2	0
362.	Shale, light- to medium-gray, carbonaceous zone in upper 1 ft, fossil plants	5	6
363.	Sandstone, light-gray, very fine grained, silty, thin and irregularly bedded	3	0
364.	Shale, medium-dark-gray, very carbonaceous in top 1 ft 5 in, abundant coal laminations and fragments	4	0
365.	Sandstone, light-gray, very fine grained, silty, massive to thin-bedded at top, scattered pyrite nodules	4	7
366.	Underclay, coal laminations and chips, fossil plants and roots, silty in top 6 in; 1-in-thick carbonaceous zone at top	4	8
367.	Sandstone, medium-light-gray, very fine grained, thick-bedded to massive, silty, scattered pyrite nodules, solution cavities	5	6
368.	Shale, medium-gray, silty, silty laminations in upper 1 ft, grades laterally into unit 367	5	5
369.	Sandstone, medium-light-gray, very fine to fine-grained, mostly fine-grained, scattered pyrite nodules, thick-bedded to massive, light and dark mineral grains	6	0
370.	Shale, medium-light-gray, silty	4	0
371.	Sandstone, fine-grained, crossbedded, thin- to medium-bedded, ripple-bedded, solution cavities, pyrite nodules	15	0
372.	Shale, medium-gray, scattered fossil plants, some iron-stained	1	8
373.	Sandstone, medium-light-gray, very silty, nonresistant	1	0
374.	Shale, medium-dark-gray to brown, bedded, abundant fossil plants, scattered plant laminations	1	6
375.	Underclay, fossil rootlets, silty		7
376.	Shale, medium-dark-gray, carbonaceous, abundant coal chips, fossil plant fragments, coaly laminations		5
377	Shale, medium-light-gray, poorly bedded, fossil plants		5
378.	Siltstone, medium-light-gray, poorly bedded, fossil plants	1	2
379.	Shale, medium-gray, poorly bedded, few scattered fossil plants, 6-in silty lens 1 ft above base	2	1
380.	Siltstone, medium-light-gray, poorly bedded, scattered fossil plants		4
381.	Shale, medium-light-gray, fossil plants, top sharp	2	6
382.	Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, thick-bedded, scattered pyrite nodules	2	2
383.	Shale, medium-dark-gray, carbonaceous, abundant fossil plants and coal chips, poorly bedded	1	7
384.	Siltstone, light-gray, sandy, poorly bedded	1	0
385.	Shale, light-gray, poorly bedded, silty at top	1	0

	Thickness	
	Ft	in
386. Siltstone, medium-light-gray, poorly bedded		4
387. Siltstone, light-gray, nonbedded, sandy		10
388. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, crossbedded, thin- to thick-bedded, scattered pyrite nodules; 1-ft-thick silty zone at top	6	0
389. Shale, medium-light-gray, few scattered fossil plants	1	3
390. Siltstone, very calcareous, thin and irregularly bedded, iron-stained		8
391. Sandstone, medium-light-gray, very fine grained, silty, interbedded with about 30 percent light-gray shale	2	4
392. Siltstone, medium-light-gray, scattered fossil plants, poorly bedded		6
393. Shale, light-gray, silty, scattered fossil plants		9
394. Sandstone, light-gray, fine-grained, friable, dark and light mineral grains	1	1
395. Siltstone, medium-gray, nonbedded		2
396. Sandstone, light-gray, very fine to fine-grained, silty in basal 2 ft, dark and light mineral grains, thin and irregularly bedded, some ripple bedding, calcareous toward top, 1-ft-2-in-thick silty lens 2 ft from top	15	6
397. Shale, medium-light-gray, poorly bedded, scattered fossil plants, scattered silt laminations, becomes silty at top	5	8
398. Siltstone, medium-light-gray, iron-stained, thin- to poorly bedded		10
399. Shale, light-gray, very silty	1	0
400. Shale, dark-gray, carbonaceous, scattered silt laminations about 15 percent; 2-in-thick silt lamination 1½ ft above base; scattered coal chips and fragments in a 2-ft-wide zone on bedding surface top	6	0
401. Siltstone, light-gray, thin- to poorly bedded, sandy, top grades into unit 402	1	0
402. Shale, medium-dark-gray, silty, slightly carbonaceous, fossil plants	1	2
403. Sandstone, light-gray, fine-grained, dark and light mineral grains, crossbedded	1	2
404. Sandstone, medium-light-gray, very fine grained, very silty, more silty at top	2	10
405. Shale, medium-light-gray, poorly bedded, scattered small gypsum crystals, crossbeds, grades silty toward top	2	5
406. Sandstone, light-gray, calcareous, very fine to fine-grained, abundant light and dark mineral grains, mostly dark, scattered shale chips, few pyrite nodules, irregularly bedded. Dip 30° SW., strike 120°	2	6
407. Sandstone, light-gray, very fine grained, very silty, dark and light mineral grains, abundant dark grains	2	0
408. Shale, medium-dark-gray, carbonaceous, few coal fragments		7
409. Sandstone, medium-light-gray, very fine grained, very silty, abundant pyrite nodules		6
410. Shale, medium-gray, poorly bedded; ½-in-thick layer of gypsum 1½ ft from top, carbonaceous in top 1 ft	2	10
411. Shale, dark-gray, carbonaceous, scattered fossil plants	1	1
412. Underclay, silty, very carbonaceous, scattered coal chips, abundant fossil root impressions		11
413. Shale, carbonaceous, poorly bedded to nonbedded, very carbonaceous; about 30 percent bright coal laminations and chips		3
414. Coal, bony, bright to dull, resin blebs		1
415. Shale, dark-brown-gray, very carbonaceous, abundant coal laminations and chips		5
416. Shale, medium-gray, abundant fossil plants, very silty to slightly sandy		11
417. Sandstone, light-gray, very fine grained, dark and light mineral grains, scattered small pyrite nodules, friable, poorly bedded to medium-bedded, top sharp	4	2
418. Shale, medium-gray, scattered fossil plants; 2-in carbonaceous shale units 1½ ft below top and 3 ft below top	18	6
419. Siltstone, light-gray, calcareous, poorly bedded		7
420. Underclay, medium-gray, fossil roots, silty, scattered small gypsum crystals		3
421. Coal, mostly bright		1
422. Shale, medium-gray, abundant fossil plants		10
423. Sandstone, very fine grained, dark and light mineral grains, thin- to poorly bedded, scattered pyrite nodules		8
424. Shale, light-gray		5
425. Sandstone, light-medium-gray, nonbedded		7
426. Shale, medium-gray, top grades into unit 427	1	0
427. Sandstone, light-gray, fine-grained, dark and light mineral grains, few scattered pyrite nodules, scattered shale laminations up to 5 in thick, lower half of unit massive, top half thin and irregularly bedded	15	0
428. Shale, medium-gray, slightly carbonaceous at base, silty toward top	1	0
429. Sandstone, light-gray, nonresistant, nonbedded	1	6
430. Shale, medium-light-gray, abundant fossil plants, nonbedded		6
431. Sandstone, light-gray, very sandy, fossil plants	1	3
432. Sandstone, light-gray, very fine grained, few dark mineral grains, friable, nonresistant	15	0
433. Sandstone, sandy-light-gray, nonbedded, nonresistant	1	4
434. Underclay, light-gray, scattered fossil plants and roots	1	1
435. Sandstone, light-gray, nonbedded		3
436. Shale, medium-gray, slightly carbonaceous	1	7

	Thickness	
	Ft	in
437. Sandstone, light-gray, very fine grained, weathered dark-brown to black owing to high iron content, thin- to poorly bedded		4
438. Shale, medium- to dark-gray, slightly carbonaceous; gray silt at top	2	3
439. Sandstone, light-gray, very fine grained, very silty, scattered light and dark mineral grains, thin- to poorly bedded, very calcareous, scattered pyrite nodules up to 4 inches in diameter	2	1
440. Shale, medium-gray, becomes silty toward top	3	4
441. Sandstone, light-gray, thin- to poorly bedded		6
442. Shale, medium-light-gray, poorly bedded, scattered fossil plants	1	2
443. Sandstone, light-gray, friable, thin and irregularly bedded		9
444. Shale, medium-gray, poorly bedded	1	9
445. Sandstone, light-gray, iron-stained, poorly bedded		6
446. Shale, light-gray, silty	1	0
447. Sandstone, light-gray, fine-grained, dark and light mineral grains, friable, scattered pyrite nodules, thin crossbeds, thick-bedded	5	0
448. Shale, medium-gray, carbonaceous in top 4 in	1	0
449. Sandstone, light-gray, very fine grained		8
450. Shale, light-gray		6
451. Sandstone, light-gray, friable		8
452. Shale, light-gray, fossil plant fragments		6
453. Sandstone, light-gray, very fine to fine-grained		8
454. Sandstone, light- to medium-gray, thinly bedded, iron-stained in upper 1 ft	3	0
455. Sandstone, very fine grained, friable, medium-bedded, crossbedded, pyrite nodules, scattered sharp, massive beds on top	8	6
456. Shale, light- to medium-gray, carbonaceous, 1-ft sandstone band at base	5	0
Total measured thickness of main body of Mesaverde Formation	1,583	2
White sandstone member of Mesaverde Formation:		
457. Sandstone, light-gray with scattered pink grains, fine- to medium-grained, light and dark mineral grains, pyrite nodules, thin-bedded in basal portion, quartz-filled joints	56	0
458. Shale, light- to medium-gray, sandstone band 1 ft above base; 2-in-thick siltstone band 1 ft from top	7	0
459. Sandstone, light-gray, fine- to medium-grained, light and dark mineral grains, thin-bedded, solution cavities	1	4
460. Shale, medium-gray; 6-in-thick carbonaceous shale, medium-gray; 2-in-thick siltstone, sandy; fossil plant fragments	2	0
461. Sandstone, light-gray, very fine grained, solution cavities		4
462. Shale, upper 6 in medium-brownish-gray, carbonaceous, lower half medium-gray	1	0
463. Sandstone, light-gray, fine- to medium-grained, thin-bedded, crossbedded, solution cavities, scattered pyrite nodules	57	0
464. Shale, light- to medium-gray	1	0
465. Siltstone, sandy		4
466. Shale, light- to medium-gray, carbonaceous in basal 6 in	10	0
467. Sandstone, light-gray, fine- to medium-grained medium- to poorly bedded, pyrite nodules, solution cavities, light and dark mineral grains, mineral-filled joints with iron carbonate; fossil invertebrate shells in basal portion	36	0
468. Shale, light- to medium-gray, carbonaceous at top		8
469. Sandstone, light-gray, fine- to medium-grained, iron-stained, thick-bedded, nonresistant, light and dark mineral grains toward top	17	0
Total measured thickness of white sandstone member of Mesaverde Formation	189	8
Total measured thickness of Mesaverde Formation	1,772	10
Meeteetse Formation:		
470. Shale, light-medium-gray, carbonaceous, crossbedded	7	0
471. Sandstone, medium-grained, dark and light mineral grains, thin- to poorly bedded, scattered pyrite nodules	1	8
472. Shale, medium-gray, highly weathered, silty	15	0
473. Shale, medium-gray, carbonaceous	6	0
474. Sandstone, very light gray, fine- to medium-grained, dark and light mineral grains, crossbedded, medium- to poorly bedded, scattered pyrite nodules	11	0
475. Shale, medium-gray, deeply weathered, 2 ft of shale 4 ft above base	22	0
476. Sandstone, very light gray, fine- to medium-grained, dark and light mineral grains, medium-bedded, crossbedded, solution cavities	27	0
Total measured thickness of Meeteetse Formation	99	8

Top of section

Measured section 2: Cody Shale through Meeteetse Formation

Location: Eagle Point Quadrangle, Wyoming (7.5 min)

Start: SE–NE–NE sec. 13, T. 6 N., R. 1 W. Presented from oldest to youngest

End: SW–SW–NE sec. 18, T. 6 N., R. 1 E.

Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.

Strike 175°, Dip 22° NE.

	Thickness	
	Ft	in
Upper Cretaceous:		
Cody Shale:		
1. Shale	50+	
Total measured thickness of Cody Shale	50+	
Mesaverde Formation:		
2. Sandstone, light-medium-gray, very fine to fine-grained, dark and light mineral grains, iron-stained, thin-bedded		6
3. Shale, medium-dark-gray, fissile		4
4. Sandstone, light-gray, very fine grained, thin and irregularly bedded		7
5. Shale, medium-gray		3
6. Sandstone, very fine grained, thin-bedded	1	4
7. Shale, medium-gray		3
8. Sandstone, light-gray, very fine grained, thin-bedded	2	0
9. Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, massive, friable, calcareous, pyrite nodules, solution cavities	11	6
10. Shale, medium-gray	2	8
11. Shale, medium-gray, interbedded with very fine grained sandstone laminations	3	0
12. Sandstone, light-gray, very fine to medium-grained, dark and light mineral grains, massive, solution cavities, scattered pyrite nodules, grades into medium-grained sandstone toward top, iron-stained	15	0
13. Sandstone, light-gray, very fine grained, silty, scattered pyrite nodules, 50 percent siltstone interbeds	5	8
14. Sandstone, light-gray, very fine to fine-grained, scattered pyrite nodules, solution cavities	2	9
15. Sandstone, light-gray, fine-grained, thin-bedded, iron-stained	1	2
16. Shale, medium-dark-gray; 2-in-thick sandstone lamination 8 in below top; scattered gypsum crystals	2	4
17. Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thick-bedded, solution cavities, pyrite nodules	4	0
18. Sandstone, light-gray, fine-grained, thin-bedded	2	0
19. Sandstone, light-medium-gray, fine-grained, iron-stained, thin- to thick-bedded, solution cavities, pyrite nodules	1	10
20. Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, nonresistant, massive	4	6
21. Sandstone, light-gray, fine-grained, thin-bedded, silty, scattered pyrite nodules up to 3 inches in diameter	4	10
22. Sandstone, light-gray, fine-grained, scattered pyrite nodules up to 6 inches in diameter, solution cavities	12	6
23. Sandstone, light-gray, very fine to fine-grained, thin-bedded, silty, pyrite nodules, nonresistant	3	0
24. Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thick-bedded to massive, calcareous; 8-in-thick very calcareous zone 2 ft below top; solution cavities, pyrite nodules	75	7
25. Sandstone, white, very fine to fine-grained, dark and light mineral grains, noncalcareous	32	0
26. Shale, dark-gray, carbonaceous, fossil plants, scattered gypsum crystals		10
27. Sandstone, medium-gray, very fine to fine-grained, silty, thin-bedded, fossil plants		10
Base of Maverick Spring coal zone		
28. Underclay, medium-gray, silty, gypsum crystals, carbonaceous toward top, fossil roots		4
29. Coal, bright, bony at base, resin		5
30. Shale, medium-gray; 1-in-thick gypsum band 6 in above base; 5-in-thick very fine grained silty sandstone ledge 2 ft below top	16	0
31. Sandstone, light-gray to white, very fine to fine-grained, thin-bedded, noncalcareous	1	8
32. Underclay, dark-brownish-gray, silty, abundant fossil plants and roots		3
33. Coal, bright, medium cleats		11
34. Underclay, dark-brownish-gray, very carbonaceous, abundant fossil plants		3
35. Coal, bright, resin, few medium cleats	1	2
36. Underclay, light-brownish-gray, very silty, fossil root impressions		2
37. Coal, bright, resin, few cleats	1	0
38. Siltstone, light-brownish-gray, sandy, scattered coal fragments		2
39. Siltstone, light-brownish-gray, sandy, thin and irregularly bedded	2	0
40. Sandstone, medium-light-gray, very fine grained, very silty, thin and irregularly bedded	3	6
41. Shale, dark-brownish-gray, abundant coal laminations, carbonaceous		1
42. Shale, light-brownish-gray, abundant plant fossils and carbonaceous material		3
43. Shale, medium-gray	2	0
44. Sandstone, light-medium-gray, very fine grained, thin-bedded	1	8
45. Shale, medium-brownish-gray, carbonaceous, fossil plants		3
46. Underclay, medium-light-gray, silty, fossil plants		6
47. Shale, medium-gray, carbonaceous, scattered fossil plants in upper 2 in	1	0
48. Shale, medium-gray		6
49. Shale, medium-brownish-gray, carbonaceous, fossil plants		8
50. Bone, coal laminations and fragments		6
51. Coal, mostly bright, resin, fine to medium cleats		4
52. Underclay, dark-brownish-gray, very carbonaceous, fossil plant and root prints		8

	Thickness	
	Ft	in
53. Shale, dark-brownish-gray, carbonaceous		8
54. Shale, medium-gray		4
55. Shale, medium- to dark-brownish-gray	1	2
56. Underclay, medium- to dark-brownish-gray, very carbonaceous, fossil plant and root prints		2
57. Coal, highly weathered, mostly bright, resin		5
58. Shale, medium-dark-brownish-gray, carbonaceous		2
59. Shale, light- to medium-gray, silty, upper 2 in carbonaceous	1	0
60. Shale, medium-gray, coal laminations		8
61. Siltstone, light-gray, thin-bedded; 30 percent very fine grained sandstone, sandstone laminations up to 3 in thick, very calcareous	6	0
62. Shale, light-medium-gray	2	0
63. Siltstone, medium-gray, scattered fossil plants		4
64. Shale, carbonaceous	1	10
65. Sandstone, light-gray, very fine to fine-grained, light and dark mineral grains, massive, iron-stained, pyrite nodules	3	4
66. Shale, medium-gray, scattered pyrite nodules, top sharp and undulatory	2	1
67. Sandstone, light-gray, very fine to fine-grained, dark and light mineral grains, massive, solution cavities, scattered pyrite nodules up to 6 inches in diameter, top 1–2 in very calcareous	55	0
68. Shale, medium-gray, weathered	6	0
69. Sandstone, light-gray to white, very fine to fine-grained, dark and light mineral grains	5	0
70. Shale, light-gray		6
71. Underclay, dark-brownish-gray, silty, very carbonaceous, fossil plant and root prints		4
72. Coal, weathered, bony, scattered resin blebs	1	2
73. Underclay, medium-brownish-gray, carbonaceous, abundant fossil plant and root prints		4
74. Coal, bony		1
75. Shale, medium-gray		9
Top of Maverick Spring coal zone		
76. Sandstone, light-gray, very fine grained, dark and light mineral grains, thick-bedded to massive, crossbedded, silty, pyrite nodules up to 8 inches in diameter, solution cavities	44	0
77. Siltstone, medium-gray, thin- to poorly bedded, iron-stained, sandy, scattered pyrite nodules	3	0
78. Shale, light-medium-gray		7
79. Siltstone, medium-gray, fossil plants, sandy		2
80. Shale, medium-dark-grayish-brown		6
81. Sandstone, light-medium-gray, very fine to fine-grained, light and dark mineral grains		4
82. Shale, medium-gray		1
83. Shale, medium-gray, silty		10
84. Shale, medium-grayish-brown, carbonaceous		5
85. Coal, weathered, bright laminations, bony		7
86. Shale, medium-brownish-gray, carbonaceous, fossil plants		2
87. Shale, medium-gray, 5 percent fibrous gypsum	1	0
88. Sandstone, light-gray, fine-grained, dark and light mineral grains, silty, iron-stained, thin and irregularly bedded, solution cavities, pyrite nodules	5	0
89. Shale, medium-gray, fossil plants	2	4
90. Shale, medium-dark-brownish-gray, carbonaceous		5
91. Sandstone, very light gray, very fine to fine-grained, dark and light mineral grains, thin-bedded	2	2
92. Sandstone, light-gray, very fine grained, very silty, calcareous, massive, highly iron stained	3	10
93. Siltstone, light-gray, thin-bedded		6
94. Shale, light-gray	1	8
95. Underclay, dark-brownish-gray, carbonaceous, fossil plants and roots		7
96. Coal, bright		1
97. Shale, dark-gray, abundant coal laminations, poorly bedded, fossil plants		9
98. Siltstone, light-gray, sandy, thin-to thick-bedded, iron-stained	1	9
99. Shale, light-medium-gray, scattered carbonaceous laminations	3	0
100. Shale, carbonaceous, abundant fossil plants, coaly material		7
101. Sandstone, very light gray, very fine to fine-grained, dark mineral grains, thin- to thick-bedded	1	3
102. Shale, medium-brownish-gray, carbonaceous, poorly bedded, abundant fossil plants	1	7
103. Shale, dark-gray, carbonaceous, fossil plants		10
104. Shale medium-gray, silty, scattered gypsum crystals	1	1
105. Sandstone, light-gray, very fine grained, very silty, thin and irregularly bedded	2	2
106. Shale, dark-gray, silty, carbonaceous, scattered fossil plants, poorly bedded	1	0
107. Sandstone, light-gray, very fine grained, silty, thin and irregularly bedded, scattered pyritic nodular layers up to 1 in thick	2	8
108. Shale, medium-gray		6
109. Siltstone, medium-gray, sandy, scattered fossil plants		3
110. Underclay, dark-gray, silty, carbonaceous, fossil rootlets		9
111. Coal, highly weathered		3
112. Shale, light-gray		2
113. Sandstone, light-gray, very fine to fine-grained, scattered dark and light mineral grains, thick-bedded to massive,		

		Thickness	
		Ft	in
	crossbedded, solution cavities, scattered pyrite nodules, iron-stained	15	0
114.	Siltstone, light-gray, poorly bedded, top grades into unit 115	1	0
115.	Sandstone, light-gray, very fine grained, silty, scattered mica, thin- to poorly bedded, scattered pyrite nodules, solution cavities	2	4
116.	Shale, dark-gray	3	0
117.	Siltstone, light-gray, silty, sandy, poorly bedded		5
118.	Shale, medium-gray, silty, poorly bedded		10
119.	Siltstone, light-gray, sandy	1	3
120.	Shale, medium-dark-gray, scattered carbonaceous laminations	1	10
121.	Underclay, dark-brownish-gray, carbonaceous		6
122.	Coal, weathered, impure		4
123.	Shale, dark-gray, poorly bedded	1	4
124.	Siltstone, light-gray		9
125.	Shale, dark-gray, carbonaceous, poorly bedded		7
126.	Siltstone, medium-gray, nonresistant	1	1
127.	Sandstone, very fine grained, scattered dark and light mineral grains, silty, thin-bedded to massive, scattered pyrite nodules	2	0
128.	Siltstone, light-gray, sandy, very calcareous		10
129.	Shale, medium-gray	1	3
130.	Shale, medium- to dark-gray, slightly carbonaceous	1	6
131.	Underclay, medium-brownish-gray, carbonaceous, fossil plants		5
132.	Shale, carbonaceous, fossil plants		5
133.	Shale, light-olive-gray, poorly bedded		9
134.	Siltstone, light-gray, thin-bedded	2	3
135.	Sandstone, light-gray, very fine grained, silty, thin- to poorly bedded, crossbedded, grades to fine-grained in top 6 in	2	0
136.	Shale, medium- to medium-dark-gray thin- to poorly bedded, slightly silty	3	0
137.	Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thick-bedded, top surface of unit ripple-bedded, very calcareous		6
138.	Shale, medium-gray, silty		10
139.	Sandstone, medium-light-gray, very fine-grained, silty, thin-bedded, top grades into unit 140	1	6
140.	Shale, medium-dark-gray to medium-gray, poorly bedded	1	8
141.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, crossbedded	1	2
142.	Shale, medium-gray, thin- to poorly bedded	1	0
143.	Underclay, medium-gray, very fine-grained, silty to sandy, abundant fossil roots, carbonaceous		9
144.	Coal, bright to dull attritus, resin, fine to medium cleats, iron-stained, gypsum crystals, fusain in upper part	1	1
145.	Shale, medium-gray, silty, thin- to poorly bedded, basal 4 in medium-dark-gray, slightly carbonaceous	2	8
146.	Sandstone, medium-light-gray, very fine to fine-grained, silty, thin- to thick-bedded, crossbedded, few pyrite nodules 1/4 inch in diameter, top grades into unit 147	2	6
147.	Shale, medium-gray, silty, thin- to poorly bedded; upper 7 in thin sandstone and siltstone laminations	1	4
148.	Sandstone, light-gray, very fine grained, thin- to thick-bedded, base undulating, scattered pyrite nodules	2	0
149.	Shale, medium-gray, thin and evenly bedded		5
150.	Shale, medium-dark-gray, carbonaceous		2
151.	Coal, bright attritus, fine to medium cleats, resin		5
152.	Shale, medium-dark-gray to light-grayish-brown, silty to sandy, coal laminations, thin-bedded	3	0
153.	Sandstone, medium-gray to medium-light-gray, silt and shale laminations, thin and irregularly bedded, top grades into unit 154	2	6
154.	Siltstone, medium-gray, shaly to sandy	1	0
155.	Gypsum vein, right angle to bedding		1
156.	Sandstone, medium-gray to grayish-red and light-olive-green in top part, very silty, scattered gypsum crystals; silty spheroidal weathering shale at base	7	0
157.	Conglomerate, shale chips, medium-gray, and pyrite nodules		8
158.	Sandstone, medium-light-gray, very fine to fine-grained, silty, massive, crossbedded, scattered pyrite nodules up to 4 inches in diameter; solution cavities; 2-in-thick detrital coal bed locally at base	30	4
159.	Shale, medium-gray, silty, thin- to poorly bedded	1	8
160.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded		9
161.	Shale, medium-dark-gray, thin and evenly bedded	1	0
162.	Sandstone, medium-light-gray, very fine grained, silty, thick-bedded, lens-shaped		7
163.	Shale, medium-dark-gray, thin and evenly bedded, slightly carbonaceous, top grades into unit 164	1	0
164.	Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded, crossbedded, contains few shale laminations, slightly calcareous	3	0
165.	Shale, medium-dark-gray, thin and evenly bedded, carbonaceous, fossil plant fragments, slightly silty at top	3	0
166.	Sandstone, medium-light-gray, fine-grained, crossbedded, thin- to thick-bedded, contains few shale and siltstone laminations, shale chips up to 6 inches in length, pyrite nodules,		

	Thickness	
	Ft	in
thick-bedded at top, calcareous in top 10 ft	45	0
167. Shale, medium-gray to medium-dark-gray, with siltstone laminations 1 ft thick; calcareous siltstone band 6 ft above base, thin and evenly bedded at top; scattered sandstone lenses; nonbedded in top 2 ft	11	0
168. Sandstone, medium-light-gray, very fine to fine-grained, iron-stained, pyrite nodules, thick-bedded at base; 5-in-thick siltstone laminations 10 in below top; basal 2 ft very calcareous	3	4
169. Siltstone, medium-light-gray; basal third of unit contains fossil plant fragments and carbonaceous material; middle third of unit very fine grained sandstone containing fossil leaves; top third of unit thin and irregularly bedded and very fine grained	1	8
170. Shale, medium-gray; 2-in-thick siltstone lens 4 in above base; shale thin and evenly bedded above siltstone lens; 1-in-thick carbonaceous shale at top, poorly bedded at base	1	8
171. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, mostly massive, crossbedded, pyrite nodules, solution cavities	25	6
172. Siltstone, medium-gray to medium-light-gray, very fine grained, sandy, thin and irregularly bedded	2	4
173. Shale, medium-gray, thin and evenly bedded; 8-in-thick carbonaceous shale at top with abundant fossil plant detritus	4	10
174. Siltstone, medium-light-gray, very fine grained sandstone, thin-bedded, fossil plant fragments		8
175. Sandstone, medium-light-gray, fine-grained, massive, solution cavities, iron-stained, pyrite nodules	6	0
176. Shale, medium-gray, lower half of unit poorly bedded, upper half of unit thin and evenly bedded	3	0
177. Siltstone, medium-light-gray, very fine grained sandstone, thin and irregularly bedded, fossil plant fragments	1	4
178. Shale, light-brownish-gray to medium-dark-gray, carbonaceous, thin and evenly bedded, fossil plant fragments		6
179. Sandstone, medium-light-gray, very fine to fine-grained, crossbedded, massive, iron-stained, calcareous, solution cavities, pyrite nodules, irregularly bedded at top	5	2
180. Shale, medium-gray, thin and evenly bedded, top slightly carbonaceous in upper 1 ft	2	4
181. Siltstone, medium-light-gray, very fine grained, sandy	1	6
182. Sandstone, medium-light-gray, very fine to fine-grained, light and dark mineral grains, thin and irregularly bedded at top, thick-bedded at base, pyrite nodules, solution cavities, fossil root impressions 1 ft above base	2	2
183. Shale, medium-gray, thin and evenly bedded, carbonaceous at top with upper 1 in impure coal		6
184. Siltstone, medium-light-gray, thin and irregularly bedded, calcareous		8
185. Sandstone, medium-light-gray, very fine to fine-grained, light and dark mineral grains, massive, crossbedded, pyrite nodules, iron-stained, solution cavities	3	4
186. Shale, medium-gray, thin and evenly bedded	1	2
187. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, silty, massive	1	4
188. Shale, medium-gray, thin and evenly bedded	1	4
189. Shale, medium-dark-gray to light-grayish-brown, carbonaceous, thin and evenly bedded, abundant carbonaceous material		5
190. Siltstone, medium-gray, very calcareous, poorly bedded	1	0
191. Sandstone, medium-light-gray, very fine grained, silty	1	1
192. Shale, medium-gray, thin and evenly bedded, carbonaceous, 2-in-thick medium-dark-gray zone 4 in below top	1	6
193. Sandstone, medium-light-gray, very fine grained, silty, thick-bedded at base, top half massive, pyrite nodules, iron-stained, solution cavities; 8-in-thick shale bed 5 ft above base, medium-dark-gray, carbonaceous fragments, coaly; 5-ft-thick very calcareous layer 10 ft above base	17	6
194. Siltstone, medium-light-gray, very fine-grained sandstone, thin and irregularly bedded		10
195. Shale, medium-gray, thin and evenly bedded	1	8
196. Siltstone, medium-light-gray, very fine grained sandstone, thin and irregularly bedded	1	0
197. Shale, medium-gray, very silty, thin and evenly bedded	2	0
198. Siltstone, medium-gray, thin and irregularly bedded	1	0
199. Shale, medium-gray, silty, thin and evenly bedded	1	0
200. Siltstone, medium-gray, thin-bedded		10
201. Shale, medium-gray, thin and evenly bedded		10
202. Siltstone, medium-gray, thin and evenly bedded		8
203. Shale, medium-gray, thin and evenly bedded, few siltstone laminations at base	2	6
204. Sandstone, medium-light-gray, very fine grained, silty, iron-stained, thin and irregularly bedded, pyrite nodules, base very silty	2	0

	Thickness	
	Ft	in
205. Shale, medium-gray, thin and evenly bedded	2	0
206. Underclay, medium-gray, very sandy, fossil roots		8
207. Shale, medium-dark-gray to light-grayish-brown, carbonaceous, abundant fossil plant fragments		10
208. Underclay, medium-gray, sandy, fossil roots, base silty		10
209. Shale, light-brownish-gray, carbonaceous, abundant fossil plant fragments		10
210. Coal, fine cleats, mostly bright attritus, resin		8
211. Shale, medium-gray to medium-dark-gray, carbonaceous, thin and evenly bedded	1	2
212. Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded		10
213. Shale, medium-gray, thin and evenly bedded	2	0
214. Siltstone, medium-gray, thin-bedded, very calcareous, fossil plant fragments	1	4
215. Sandstone, medium-light-gray, very fine to fine-grained, silty, fossil plant fragments, basal two-thirds of unit massive and calcareous, upper third of unit thin bedded, pyrite nodules, solution cavities	4	0
216. Shale, medium-dark-gray to light-brownish-gray, carbonaceous, fossil plant fragments, coal fragments		5
217. Coal, impure, bright, resin, gypsum crystals		2
218. Shale, light-grayish-brown, carbonaceous, silty, sandy, crossbedded, thin-bedded to thin and irregularly bedded, abundant fossil plant fragments	2	6
219. Sandstone, medium-light-gray, fine- to medium-grained, light and dark mineral grains, massive, crossbedded, calcareous concretion 4 ft long; solution cavities; pyrite nodules, few silty ±1–2-ft-thick shale beds 22 ft above base, lenticular; scattered shale chips; few shale and siltstone interbeds in top ±15 ft of unit, fossil root impressions	86	0
220. Shale, medium-gray, silty, thin and evenly bedded	1	4
221. Siltstone, medium-gray, very fine grained sandstone, fossil plant fragments		6
222. Shale, medium-gray, thin and evenly bedded	1	2
223. Siltstone, medium-gray, very fine grained sandstone		4
224. Shale, medium-gray, thin and evenly bedded, slightly carbonaceous in upper 1 ft of unit	1	4
225. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, massive, solution cavities, iron-stained in lower two-thirds of unit, calcareous, crossbedded	5	4
226. Shale, medium-gray, thin and evenly bedded, locally carbonaceous	2	0
227. Siltstone, medium-gray, sandy, poorly bedded	1	6
228. Sandstone, medium-light-gray, very fine grained, thick-bedded, solution cavities, scattered pyrite nodules, iron-stained, calcareous	2	6
229. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thin-bedded, upper 8 in calcareous, fossil roots, grades upward into unit 230	2	0
230. Underclay, medium-gray to light-brownish-gray, silty, thin-bedded to nonbedded, shaly, upper 4 in very carbonaceous	5	2
231. Coal, fine cleats, mostly bright, gypsum crystals, resin blebs		6
232. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, massive-bedded in basal 3 ft 2 in, upper part thin-bedded, solution cavities	4	0
233. Shale, medium-gray, silty in lower half of unit, thin-bedded	2	10
234. Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded	1	9
235. Shale, medium-gray, thin-bedded, fossil plants	1	0
236. Siltstone, medium-light-gray, calcareous, irregularly bedded		4
237. Shale, medium-gray, thin-bedded	1	0
238. Underclay, crossbedded, fossil roots and plants, gypsum crystals	4	0
239. Shale, medium-dark-gray, upper 10 in carbonaceous, abundant fossil plants	2	0
240. Sandstone, very fine grained, silty, iron-stained, thick-bedded to massive, slightly calcareous	4	0
241. Mudstone, calcareous, silty, concretionary	4	0
242. Sandstone, light-gray, very fine grained, very silty, thin- to medium-bedded	1	0
243. Underclay, medium-dark-gray, thin and irregularly bedded, slightly silty, fossil roots and plants	1	6
244. Coal, bony, impure, bright bands, abundant resin blebs		5
245. Shale, medium-dark-gray, nonbedded	1	4
246. Shale, light-grayish-brown, irregularly bedded		4
247. Underclay, medium-gray, slightly silty, scattered fossil plants and roots		7
248. Coal, impure, bony, some light bands, mostly dark bands		7
249. Bentonite, light-olive-gray	1	0
250. Shale, medium-gray, nonbedded	1	0
251. Underclay, medium-brownish-gray, carbonaceous, abundant fossil roots and plants		6
252. Coal, light to dark bands, finely cleated, scattered resin		6

	Thickness	
	Ft	in
253. Shale, dark-brownish-gray, carbonaceous, abundant bright coal lenses, abundant fossil plants and roots, thin- to irregularly bedded		5
254. Shale, medium-gray, thin-bedded, few siltstone laminations up to 4 in thick	9	0
255. Underclay, medium-gray, silty, thin and irregularly bedded, abundant fossil roots and plants	1	6
256. Shale, dark-grayish-brown, carbonaceous, thin-bedded, scattered fossil plants		8
257. Shale, light-medium-gray, thin- to irregularly bedded, scattered fossil plants; ½-in-thick coal lens 9 in below top of unit	1	3
258. Sandstone, very fine grained, very silty, crossbedded, thin-bedded at base, massive toward top, silty, calcareous	3	2
259. Shale, medium-gray, thin-bedded	1	3
260. Shale, medium-dark-gray, silty, carbonaceous, scattered fossil plants	1	4
261. Underclay, dark-brownish-gray, very silty, abundant fossil roots and plant fragments	1	0
262. Shale, medium-dark-gray, thin and evenly bedded, scattered fossil plants	1	6
263. Sandstone, light-medium-gray, very fine grained, thin- to thick-bedded, very silty, scattered pyrite nodules	1	0
264. Shale, medium-gray, thin and evenly bedded		6
265. Shale, dark-brownish-gray, carbonaceous, scattered bright coal laminations, abundant fossil plants		6
266. Sandstone, medium-light-gray, very fine to fine-grained, abundant dark and light mineral grains, scattered pyrite nodules	1	4
267. Shale, medium-gray, thin and evenly bedded		8
268. Shale, dark-brownish-gray, carbonaceous, thin and irregularly bedded, abundant bright coal laminations, scattered fossil plant fragments	1	6
269. Shale, medium-gray, thin-bedded		10
270. Underclay, medium-gray, thin-bedded, fossil roots and plants		5
271. Coal, bright, finely cleated		1
272. Shale, medium-dark-gray, very silty, poorly bedded, scattered fossil plants		8
273. Siltstone, medium-gray, nonbedded; 3-in-thick grayish-red iron-stained band 10 in below top	5	0
274. Underclay, medium-gray, very silty, abundant gypsum crystals, fossil roots	3	10
275. Claystone, medium-gray, scattered gypsum veins, irregularly bedded, silty, very sandy in basal 1½ ft	4	6
276. Sandstone, medium-gray, fine-grained, few dark and light mineral grains, very silty, thin- to thick-bedded, scattered pyrite nodules	6	0
277. Siltstone, medium-gray, nonbedded, sandy	1	2
278. Shale, medium-dark-gray, thin and evenly bedded, slightly silty, few scattered fossil plants	5	0
279. Shale, dark-grayish-brown, carbonaceous, thin and irregularly bedded, abundant fossil plants	1	0
280. Shale, medium-gray, thin-bedded	2	0
281. Siltstone, medium-gray, thin and irregularly bedded, very calcareous	4	0
282. Shale, medium-gray, thin-bedded, silty, carbonaceous in upper 3 in, scattered fossil plants, scattered siltstone laminations	4	6
283. Sandstone, light-gray, fine- to medium-grained, scattered light and dark mineral grains, scattered pyrite nodules, grades laterally to thin-bedded siltstone	6	6
284. Shale, medium-gray, thin-bedded	3	6
285. Shale, carbonaceous, thin and irregularly bedded, scattered coal laminations, abundant fossil plants, slightly silty	2	0
286. Underclay, medium-dark-gray, very silty, fossil roots	2	0
287. Coal, bright, scattered resin blebs		1
288. Underclay, medium-dark-brownish-gray, abundant coal fragments and laminations, fossil plant material, very silty, slightly sandy	2	10
289. Shale, light-brown-gray, carbonaceous		2
290. Sandstone, very fine to fine-grained, silty, scattered pyrite nodules up to 3 inches in diameter; interbedded with light-gray siltstone, thin- to thick-bedded, crossbedded, includes large gypsum fault filling	30	0
291. Sandstone, light-gray, very fine to fine-grained, silty, crossbedded, few pyrite nodules, base sharp, top 6 ft thin-bedded	18	0
292. Siltstone, light-gray, nonbedded, shaly, sandy	6	0
293. Shale, medium-gray, thin-bedded, scattered coal fragments	5	0
294. Sandstone, very fine grained, dark and light mineral grains, silty, thick-bedded	1	6
295. Shale, medium-gray, thin-bedded, few scattered fossil plants	1	3
296. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, thick-bedded, iron-stained, scattered pyrite nodules, solution cavities, top 2 in calcareous	1	10
297. Shale, medium-dark-gray, few fossil plants		3
298. Sandstone, very light gray, fine-grained, nonresistant, scattered dark and light mineral grains		10
299. Shale, medium-gray, thin and evenly bedded to poorly bedded, top 3 in grades		

	Thickness	
	Ft	in
into silty underclay with coal laminations	6	0
300. Shale, light-brownish-gray, carbonaceous, thin and evenly bedded, abundant coal laminations and fossil plants		5
301. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, some mica, friable, crossbedded, thin- to thick-bedded, solution cavities, few scattered pyrite nodules	5	0
302. Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded; 1-in-thick medium-gray shale band 6 in above base	2	4
303. Shale, medium-gray, thin and evenly bedded	6	0
304. Shale, light-brownish-gray, carbonaceous, thin and irregularly bedded, scattered fossil plants		6
305. Sandstone, medium-light-gray, very fine grained, very silty, thin-bedded, fossil root impressions in top 4 in	2	0
306. Underclay, medium-gray, fossil rootlets	2	10
307. Sandstone, medium-light-gray, very fine-grained, very silty, fossil roots	1	5
308. Underclay, medium-gray, very silty, fossil roots, scattered fossil plants; ½-in-thick coal laminations 2 in below top	1	10
309. Coal, bright, scattered resin blebs, few cleats		1
310. Shale, light-brown-gray, carbonaceous, thin and irregularly bedded, fossil plants		6
311. Underclay, medium-gray, very silty, nonbedded, fossil roots, top grades into unit 312	2	6
312. Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded, shaly, few pyrite nodules	1	6
313. Shale, medium-gray, silty, thin and evenly bedded	2	10
314. Siltstone, medium-light-gray, thin and irregularly bedded, grades sandy upward	1	0
315. Shale, medium-gray, thin and evenly bedded; 4-in-thick pyrite nodular band 3 ft below top; top 2 ft silty, top grades into unit 316	6	0
316. Sandstone, medium-light-gray, very fine grained, very silty, thin- to thick-bedded; 3-in-thick medium-gray shale bed 6 in below top	2	4
317. Shale, medium-gray, thin and evenly bedded	2	0
318. Shale, light-brownish-gray, carbonaceous, thin and evenly bedded, scattered fossil plants		6
319. Shale, medium-gray, thin- to poorly bedded	5	0
320. Underclay, medium-gray to light-grayish-brown, thin and irregularly bedded, fossil roots, scattered fossil plants, resin blebs		9
321. Shale, light-brownish-gray, carbonaceous, silty, scattered fossil plants		5
322. Shale, medium-gray, silty, thin- to irregularly bedded, few scattered siltstone laminations	3	6
323. Shale, light-brownish-gray, carbonaceous, scattered fossil plants	1	6
324. Underclay, medium-gray, light-brownish-gray, very silty, top 3 in contains abundant fossilized carbonaceous roots	1	2
325. Siltstone, medium-gray, grades sandy at top, thin- to medium-bedded toward top, iron-stained, calcareous, scattered pyrite nodules to 2 inches in diameter	4	6
326. Shale, medium-gray, thin- to poorly bedded	3	0
327. Underclay, light-brownish-gray, fossil roots, few scattered fossil plants		9
328. Shale, dark-brownish-gray, scattered coal laminations		4
329. Shale, medium-gray with 3-in-thick medium-dark-gray carbonaceous shale 1½ ft above base, scattered gypsum crystals	7	0
330. Siltstone, medium-light-gray, sandy, very fine grained, iron-stained	1	8
331. Shale, medium-gray, thin-bedded	1	0
332. Shale, dark-brownish-gray, carbonaceous, coal chips, fossil plants		6
333. Siltstone, medium-gray, shaly, thin and poorly bedded, some iron stains, basal contact undulating	2	6
334. Sandstone, medium-light-gray, very fine to fine-grained, friable, silty, thick-bedded to massive, scattered pyrite nodules at top	3	4
335. Shale, dark-grayish-brown, carbonaceous; 1½-in-thick bony coal 10 in below top	1	6
336. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thick-bedded to massive; top 2 ft contains many carbonaceous fragments; few silty shaly beds approximately 3 in thick; basal 1 ft silty, very carbonaceous, fossil plant fragments; top 2 ft very silty, friable	8	10
337. Sandstone, medium-light-gray, very fine to fine-grained, few shale chips, massive, solution cavities, pyrite nodules, few crossbeds, calcareous, calcareous concretions up to 3 ft in diameter	10	0
338. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, silty, sandy, fossil plant fragments, carbonaceous	1	3
339. Sandstone, medium-light-gray, fine-grained, thin-bedded		10
340. Siltstone, medium-gray, poorly bedded, very sandy, upper half thin-bedded, few pyrite nodules	4	6
341. Shale, medium-dark-gray to light-grayish-brown, thin-bedded, abundant fossil		

		Thickness	
		Ft	in
	plant fragments, carbonaceous; few coal fragments and fusain bands up to 1 inch in length, upper half of unit light gray	2	2
342.	Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded, calcareous, iron-stained	1	6
343.	Shale, medium-gray, thin- to poorly bedded	3	0
344.	Underclay, medium-gray, fossil roots, slightly carbonaceous	1	6
345.	Shale, carbonaceous, medium-dark-gray to light-grayish-brown, abundant fossil plant and coal fragments, thin and evenly bedded		4
346.	Shale, medium-gray, thin- to poorly bedded, slightly carbonaceous in upper 1 ft	4	6
347.	Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, slightly calcareous	2	8
348.	Shale, medium-gray, thin and evenly bedded, slightly carbonaceous, few fossil roots in upper 6 in	1	10
349.	Shale, medium-dark-gray to dark-grayish-brown, very carbonaceous, gypsum crystals, coal laminations, silty	1	2
350.	Shale, medium-gray, thin and evenly bedded	1	3
351.	Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, silty, pyrite nodules	1	6
352.	Shale, medium-dark-gray to medium-gray, very carbonaceous; basal 4 in, fossil plants and coal fragments; 8-in-thick carbonaceous zone 3 ft above base; upper 2 ft poorly bedded	5	10
353.	Siltstone, medium-gray, thin and irregularly bedded, sandy	1	1
354.	Underclay, medium-gray to light-grayish-brown, fossil roots; 2-in-thick × 10-in-long detrital coal lens 1 ft above base; very silty, 3-in-thick bone lens 4 ft below top, upper 3 in thin and evenly bedded, carbonaceous shale	2	6
355.	Sandstone, medium-gray, very fine grained, silty, thin and irregularly bedded	1	6
356.	Shale, medium-gray to medium-dark-gray, poorly bedded, upper 2 ft 2 in thin and evenly bedded, slightly carbonaceous	4	8
357.	Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, 4-in silty bed 1 ft above base, fossil roots in upper 6 in	2	8
358.	Shale, medium-gray, thin- to poorly bedded		7
359.	Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded	1	1
360.	Shale, medium-gray to medium-dark-gray, few coal fragments, top channeled and filled by unit 361	1	2
361.	Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, crossbedded, fossil roots, solution cavities, massive, upper 4 in thin-bedded	3	5
362.	Shale, medium-gray, thin and evenly bedded, top channeled and filled by sandstone unit 363		11
363.	Sandstone, medium-light-gray, very fine grained, silty, basal 7 in thin-bedded, upper 1 ft 5 in thick-bedded, calcareous, shaly, crossbedded	2	0
364.	Shale, medium-gray, thin and evenly bedded, few fossil roots, channel in upper part of unit filled by unit 365	1	2
365.	Sandstone, medium-light-gray, very fine to fine-grained, few medium grains, few siltstone laminations, crossbedded; calcareous and thin-bedded in top 2 ft; friable, solution cavities, scattered shale chips, scattered pyrite nodules	27	6
366.	Shale, medium-gray, thin- to poorly bedded	4	0
367.	Bentonite, light-olive-gray	4	0
368.	Shale, medium-gray to medium-dark-gray, slightly calcareous, thin- to poorly bedded, fossil plant fragments, grades into unit 369	9	4
369.	Sandstone, medium-light-gray, silty, very fine grained, massive at top, basal 1 ft 4 in very silty, few fossil roots	3	4
370.	Shale, medium-gray, poorly bedded	1	4
371.	Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded	1	0
372.	Shale, medium-gray, thin- to poorly bedded	1	8
373.	Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, 5-ft calcareous concretions, crossbedded, friable, few solution cavities	6	6
374.	Shale, medium-gray, thin and evenly bedded, few fossil roots	3	6
375.	Shale, medium-dark-gray to dark-grayish-brown, carbonaceous, very silty, thin and evenly bedded, coal and fossil plant fragments	1	6
376.	Shale, medium-gray, thin and evenly bedded		11
377.	Sandstone, medium-light-gray, thin and evenly bedded to thick-bedded, gypsum in fractures; 5-in-thick medium-gray shale lens 7 in below top	1	10
378.	Shale, medium-gray, nonbedded, basal 4 in very silty, top uneven	2	0
379.	Sandstone, medium-light-gray, fine-grained, thin and irregularly bedded, pyrite nodules, basal 4 in contains detrital coal fragments	2	2
380.	Shale, medium-gray, silty, sandy, thin and evenly bedded, siltstone and sandstone laminations up to 3 in	3	0
381.	Sandstone, light-gray, very fine to fine-grained, silty, thin- to thick-bedded, few solution cavities	1	8
382.	Shale, medium-gray, thin and evenly bedded, silty		4

	Thickness	
	Ft	in
383. Siltstone, medium-gray, thin- to poorly bedded, few fossil roots, top undulates	2	5
384. Sandstone, medium-light-gray, very fine to fine-grained, crossbedded, basal 2 ft contains pyrite nodules and shale chips; very calcareous, massive at top; several 2-ft-thick calcareous zones, thin bedded	13	0
385. Shale, medium-gray, thin-bedded	1	0
386. Sandstone, light-gray, very fine grained, silty	1	2
387. Shale, medium-gray, poorly bedded, few fossil roots, slightly carbonaceous in top 1 in		8
388. Ironstone, dark-reddish-brown, weathered		8
389. Shale, medium-dark-gray, thin and evenly bedded, very carbonaceous, few fossil plant fragments	1	2
390. Sandstone, medium-light-gray, very fine grained, silty	1	6
391. Shale, medium-dark-gray, thin and evenly bedded	1	2
392. Shale, medium-dark-gray to light-grayish-brown, abundance of plant fragments and prints, thin and evenly bedded, carbonaceous	1	2
393. Sandstone, medium-light-gray, very fine grained, silty	1	0
394. Shale, medium-gray, thin and evenly bedded	1	2
395. Sandstone, medium-light-gray to light-gray, very fine grained, silty, fossil roots		10
396. Shale, medium-dark-gray to dark-grayish-brown, carbonaceous, silty, poorly bedded, 1/2-in coal bed at base		9
397. Sandstone, medium-light-gray, very fine grained, silty	2	10
398. Shale, medium-gray to medium-dark-gray, thin-bedded, scattered fossil plants; 6-in-thick carbonaceous zone 2 ft above base; upper 1 ft very carbonaceous	4	6
399. Siltstone, medium-gray, very fine grained sandstone laminations, thin and irregularly bedded, calcareous	1	0
400. Sandstone, light- to medium-gray, very fine grained, thin-bedded, pyrite nodules	3	6
401. Shale, medium-gray	1	0
402. Sandstone, light-gray, very fine grained, silty	2	10
403. Shale, medium-gray, thin and evenly bedded		5
404. Shale, medium-dark-gray, very calcareous, silty, nonbedded; 7-in-thick medium-dark-gray shale 7 in above base	3	0
405. Siltstone, light-gray, thin-bedded, ironstained	1	0
406. Shale, medium-dark-gray, slightly carbonaceous	1	10
407. Sandstone, light-gray to white, fine-grained, few medium-grained, silty, crossbedded, friable, solution cavities, pyrite nodules	3	8
Total measured thickness of main body of Mesaverde Formation	1,292	5
White sandstone member of Mesaverde Formation:		
408. Sandstone, light-gray to white, fine-grained, some medium-grained, dark and light mineral grains, thick-bedded to massive, crossbedded, scattered pyrite nodules, solution cavities; 4 ft of medium-gray shale laminations 125 ft above base; shale chips 135 ft above base; coarsens upward; 10-ft quartzose ledge 15 ft below top	237	0
Total measured thickness of white sandstone member of Mesaverde Formation	237	0
Total measured thickness of Mesaverde Formation	1,529	5
Meeteetse Formation:		
409. Shale, medium-gray, thin and evenly bedded, thin- to thick-bedded at top, friable	1	6
410. Shale, medium-brownish-gray, thin and evenly bedded	1	8
411. Shale, medium-brownish-gray, carbonaceous, thin and irregularly bedded, abundant fossil plants; 1½-in-thick sandstone lens 10 in below top	2	0
412. Shale, medium-brownish-gray, carbonaceous, thin and evenly bedded	1	2
413. Underclay, medium-brownish-gray, carbonaceous, silty, fossil plants and roots	1	4
414. Shale, medium-gray, thin and irregularly bedded, sandstone lens 10 in below top	1	10
415. Shale, dark-brownish-gray, carbonaceous, silty, poorly bedded, fossil plants	1	2
416. Siltstone, medium-gray, thin- to poorly bedded	4	6
417. Sandstone, light-medium-gray, very fine to fine-grained, dark and light mineral grains, thick-bedded to massive; 10-in-thick siltstone with thin-bedded laminations 1½ ft above base, crossbedded, pyrite nodules, solution cavities, medium-grained at top	30	0
418. Shale, medium-brownish-gray, carbonaceous, thin and irregularly bedded	3	0
419. Shale, medium-brownish-gray, carbonaceous, thin and irregularly bedded, fossil plant fragments	1	2
420. Shale, medium-grayish-brown, carbonaceous, thin and evenly bedded	3	4
421. Shale, medium-brownish-gray, carbonaceous, thin and irregularly bedded, fossil plants in lower half of unit	2	2

	Thickness Ft	Thickness in
422. Sandstone, medium-light-gray, fine- to medium-grained, scattered dark and light mineral grains, iron-stained, thin- to thick-bedded, solution cavities, scattered pyrite nodules, becomes silty at top	3	4
423. Shale, lower 1½ ft medium-gray, thin and irregularly bedded, top carbonaceous, thin and evenly bedded	3	4
424. Sandstone, light-gray, very fine grained, light and dark mineral grains	1	2
425. Shale, medium-brownish-gray, carbonaceous, abundant fossil plants, thin and evenly bedded in top 1 ft	2	0
426. Sandstone, light-medium-gray, medium-grained, dark and light mineral grains, iron-stained		8
427. Shale, medium-brownish-gray, thin-bedded, weathered	16	0
428. Sandstone, light-gray, fine- to medium-grained, crossbedded, thick-bedded, iron-stained, solution cavities, scattered pyrite nodules	15	10
429. Shale, medium-gray, weathered	6	0
430. Sandstone, medium-gray, very fine grained, dark and light mineral grains, silty	1	6
431. Shale, medium-gray, thin and evenly bedded, slightly bentonitic, carbonaceous in top 1 ft	5	6
432. Bentonite, light-olive-gray	1	4
433. Shale, medium-gray, weathered	9	6
434. Sandstone, light-gray, fine grained, crossbedded, weathered, scattered pyrite nodules, calcareous and thin-bedded in top 3 ft	15	0
435. Shale, medium-gray to medium-dark-gray, poorly bedded, weathered, top 1 ft carbonaceous and coal fragments, very fissile at top	6	0
436. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thick-bedded to massive, scattered pyrite nodules	16	0
437. Shale, light-medium-gray, carbonaceous	1	0
438. Sandstone, light-medium-gray, very fine-grained, scattered dark and light mineral grains, silty, weathered	6	0
Total measured thickness of Meeteetse Formation	165	0

Alluvial Cover

End of section

Measured section 3: Meeteetse Formation through Fort Union Formation

Location: Eagle Point Quadrangle, Wyoming (7.5 min)

Start: SW–SE–NW sec. 17, T. 6 N., R. 1 E. Presented from oldest to youngest

End: SW–NE–NE sec. 21, T. 6 N., R. 1 E.

Described by: J.F. Windolph, Jr.

Strike 170°, Dip 25° E.

Upper Cretaceous:

Meeteetse Formation: (Units 1–33 not described in detail)	Thickness Ft	Thickness in
1. Sandstone	10	0
2. Shale	6	0
3. Sandstone	10	0
4. Shale	10	0
5. Sandstone	1	6
6. Shale, carbonaceous	3	0
7. Shale	1	6
8. Sandstone, massive with shale chips	15	0
9. Shale	8	0
10. Sandstone, calcareous	5	0
11. Sandstone, massive	27	0
12. Underclay	1	0
13. Coal	1	0
14. Shale	2	0
15. Sandstone	1	6
16. Shale with underclay	5	0
17. Coal	2	0
18. Bone		8
19. Coal		10
20. Sandstone	13	0
21. Shale	15	0
22. Sandstone, massive	30	0
23. Shale	20	0
24. Coal	1	6
25. Shale	9	0
26. Sandstone	3	0
27. Shale	9	0
28. Sandstone	3	0
29. Sandy bentonite	4	0
30. Sandstone	2	0
31. Shale	5	0
32. Sandstone	3	0
33. Shale, carbonaceous	10	0
34. Underclay, upper part very carbonaceous with bone 7 in thick	4	0
Welton coal bed		
35. Coal, bright; 7-in-thick bony zone 2½ ft below top; upper 2 ft impure; fine-to-medium cleats (Woodruff and Winchester, 1912, pl. L, no. 71)	15	2
36. Shale, medium-dark-gray to light-grayish-brown, carbonaceous, bony, silty to sandy	1	4
37. Shale, medium-gray to medium-dark-gray, nonbedded, few fossil roots	9	0
38. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	0
39. Shale, medium-gray, silty, thin- to poorly bedded, upper part contains a few lenses of sand grains	2	6
40. Sandstone, medium-light-gray, very fine grained, few fossil roots	1	7
41. Siltstone, medium-gray, abundant fossil roots	1	8
42. Shale, medium-dark-gray to medium-gray, basal 1 ft slightly carbonaceous, few thin, calcareous, silty bands	5	0
43. Sandstone, medium-light-gray, thin-bedded, very fine grained, silty, calcareous, ripple-bedded		5
44. Shale, medium-gray, nonbedded	4	6

	Thickness Ft	 in
45. Sandstone, medium-light-gray, fine-grained, very calcareous, ripple-bedded and crossbedded	3	0
46. Sandstone, medium-light-gray, very fine grained, silty, shaly, friable, two thin calcareous beds	3	6
47. Shale, medium-gray, thin- to poorly bedded, few fossil rootlets	5	6
48. Shale, medium-dark-gray to light-grayish-brown, thin-bedded, very carbonaceous	2	0
49. Coal, bright, fine to medium cleats, gypsum crystals	1	8
50. Coal, bony		3
Total measured thickness of Meeteetse Formation	300	7

Unconformity

Lance Formation:

	Thickness Ft	 in
51. Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, friable, massive, few scattered pyrite nodules, solution cavities, calcareous concretions up to 7 ft long, petrified wood fragments 85 ft above base, petrified log 6 inches in diameter, 155 ft above base; few thin shale lenses	208	0
52. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, gypsum, crystals, few sandstone and siltstone interbeds up to 6 in thick; upper part slightly carbonaceous	19	0
53. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, crossbedded, few thin shale interbeds up to 4 in thick	6	6
54. Shale, medium-gray to medium-dark-gray, poorly bedded	9	6
55. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded	1	0
56. Shale, medium-gray, silty, poorly bedded	1	6
57. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	4
58. Shale, medium-gray to medium-dark-gray, poorly bedded	5	4
59. Sandstone, medium-light-gray, very fine grained, silty, few fossil roots, top 4 in thin-bedded	1	8
60. Shale, medium-dark-gray to grayish-brown, very carbonaceous, thin and evenly bedded, abundant fossil plant fragments	2	5
61. Shale, medium-dark-gray, poorly bedded, slightly carbonaceous; upper 8 in thin-bedded	6	2
62. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded; few fossil impressions in upper 6 in	4	0
63. Shale, medium-dark-gray to medium-gray; 1-ft-thick carbonaceous zone 9 in above base	3	0
64. Sandstone, medium-light-gray, fine-to medium-grained, few shale chips, massive, crossbedded, slump structures, few solution cavities, few thin-bedded sandstone and shale lenses, pyrite nodules 2 ft above base; upper 2 ft calcareous, very thin bedded	52	0
65. Shale, medium-gray, poorly bedded	9	6
66. Shale, medium-dark-gray to light-grayish-brown, thin and evenly bedded, very carbonaceous		10
67. Underclay, medium-gray, fossil roots, slightly shaly, bentonitic with few carbonaceous zones, few sandy shale chips, top uneven	26	0
68. Sandstone, medium-light-gray to light-gray, fine- to medium-grained, few coarse grains, dark and light mineral grains, massive, slump-bedded, solution cavities; upper half of unit thin-bedded and contains light-yellow iron-stained lenses; few calcareous zones 1 ft thick, crossbedded; upper 1 ft very fine grained, very calcareous	50	0
69. Sandstone, medium-light-gray, very fine to fine-grained, silty, thin-bedded, few very calcareous 1-ft-thick zones	10	0
70. Sandstone, medium-light-gray to light-gray, fine- to medium-grained, few very coarse-grained lenses, dark and light mineral grains, crossbedded, thin-bedded to massive	46	0
71. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, very calcareous, basal 4 in forms resistant ledge	4	0
72. Siltstone, medium-gray, very fine grained, sandy, thin and evenly bedded, very calcareous	12	0
73. Shale, medium-gray, poorly bedded	7	0
74. Sandstone, medium-light-gray, very fine grained, silty, very calcareous, thin-bedded	3	0
75. Shale, medium-gray to medium-dark-gray, poorly bedded	5	6
76. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, few massive beds, crossbedded, upper 25 ft thin-bedded and very calcareous	135	0
77. Siltstone, medium-gray, very fine grained, very calcareous, thin-bedded	12	0
78. Shale, medium-dark-gray, nonbedded, slightly bentonitic	7	6
79. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, conglomeratic, pyrite nodules, rounded quartz and chert pebbles, and fossil bone fragments up to 1 ft in diameter, contains shale and sandstone lenses	4	0
80. Sandstone, fine- to medium-grained, few coarse grains, contain 1-ft-thick conglomerate lens and a few shale lenses	12	0
81. Sandstone, medium-light-gray, fine-to medium-grained, thin-bedded to mas-		

		Thickness	
		Ft	in
	sive, crossbedded, calcareous concretions 7 ft in diameter, few solution cavities, few pebbles 25 ft above base and 45 ft above base; upper 2 ft very calcareous	108	0
82.	Shale, medium-gray to medium-dark-gray, thin and evenly bedded, contains 8-in-thick silty sandstone 8 ft above base	11	6
83.	Sandstone, medium-light-gray, very fine grained, silty, very calcareous	1	6
84.	Sandstone, medium-light-gray, very fine grained, silty, thick-bedded	8	0
85.	Shale, medium-gray, poorly bedded	2	6
86.	Sandstone, medium-light-gray, fine- to medium-grained, massive, slightly calcareous, few solution cavities, 3 ft in diameter, calcareous concretions, few 1-ft-thick medium-gray shale lenses 25 ft above base	50	0
87.	Shale, medium-gray to medium-dark-gray, poorly bedded to nonbedded, upper 2 ft slightly carbonaceous	20	0
88.	Sandstone, medium-light-gray, very fine to fine- to medium-grained, massive, upper 1 to 1½ ft very calcareous, very ferruginous, upper 5 ft contains few shale chips	15	0
89.	Shale, medium-gray, poorly bedded to nonbedded, slightly bentonitic contains 5-ft siltstone lens	21	6
90.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, very calcareous	3	0
91.	Sandstone, fine- to coarse-grained, thin-bedded to massive, very friable, upper 4 ft very calcareous	20	0
92.	Siltstone, medium-gray, very fine grained, sandy, poorly exposed	5	0
93.	Shale, medium-gray to medium-dark-gray, poorly bedded to nonbedded, slightly bentonitic	48	0
94.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, very calcareous	20	0
95.	Shale, medium-gray to medium-dark-gray, silty, basal 2 ft slightly bentonitic	10	0
96.	Sandstone, medium-light-gray, fine- to medium-grained, thick-bedded, pyrite nodules	3+	
97.	Covered	25	0
98.	Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to massive, locally crossbedded; solution cavities; upper 1 ft very calcareous	18	0
99.	Shale, medium-gray, thin and evenly bedded, slightly bentonitic, nonbedded 6 ft above base, medium-dark-gray	25	6
100.	Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, thick-bedded to massive, crossbedded, shale chips, friable	4	6
101.	Shale, medium-dark-gray, thin and evenly bedded	1	10
102.	Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, crossbedded, shale chips, pyritic nodules, contains 3-in-thick siltstone 1½ ft above base, upper 1½ ft calcareous	4	0
103.	Shale, medium-gray, silty, thin and evenly bedded	2	6
104.	Ironstone, weathered dark-brown	1	0
105.	Shale, medium-gray, silty, bentonitic, becomes medium-dark-gray to dark-gray, nonbedded 10 ft above base	49	0
106.	Sandstone, medium-light-gray, medium- to coarse-grained, massive, pyrite nodules, contains palm tree leaf impressions	2	0
107.	Shale, medium-dark-gray to dark-gray, nonbedded, bentonitic, carbonaceous	88	0
108.	Siltstone, medium-gray, bentonitic, grades sandy upward	6	0
109.	Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, thick-bedded	1	10
110.	Siltstone, sandy, shaly, weathered, bentonitic	4	6
111.	Sandstone, medium-light-gray, fine- to medium-grained, very silty, thick and irregularly bedded lenses, few granules, shale chips	5	0
112.	Shale, medium-gray to medium-dark-gray, nonbedded, bentonitic	17	0
113.	Sandstone, medium-light-gray to olive-green, fine- to medium-grained in light portion, very fine grained to silty in green portion, unit consist of several lenses, massive to nonbedded	3	0
114.	Shale, light-olive-gray to medium-dark-gray, nonbedded, bentonitic, ash particles, upper 3 ft grades into sandy shale	15	0
115.	Sandstone, medium-light-gray, very fine grained, silty, thick-bedded to massive	3	6
116.	Shale, medium-dark-gray, nonbedded, carbonaceous	1	6
117.	Siltstone and very fine grained sandstone, thick-bedded	1	0
118.	Shale, medium-dark-gray, bentonitic, nonbedded, contains few light-olive-green siltstone lenses up to 1 ft thick, upper 1 ft grades into sandy shale	25	0
119.	Sandstone, medium-light-gray, fine- to medium-grained, thick-bedded to massive, high-angle crossbedding, shale chips, pyrite nodules	22	0
120.	Shale, light-olive-gray, silty, nonbedded, contains few silty zones up to 1½ ft thick, few medium-gray zones, slightly bentonitic	12	0
121.	Sandstone, medium-light-gray, very fine to fine-grained, silty, thick-bedded to massive, contains 9-in-thick sandy volcanic ash bed 2 ft 8 in above base	6	0

	Thickness	
	Ft	in
122. Shale, medium-gray to light-olive-gray, bentonitic, silty, nonbedded----------	5	0
123. Sandstone, medium-light-gray, very fine to fine-grained, silty, thick-bedded to massive ----------------------------	3	6
124. Shale, medium-gray to medium-dark-gray, contains 1 ft light-olive zone, medium-grained, silty sandstone 2 ft above base, bentonitic---------------	6	0
125. Sandstone, medium-light-gray, very fine to fine-grained, silty, thick-bedded to massive, crossbedded, noncalcareous, contains 1-ft-thick volcanic ash bed 2 ft below top -------------------------	8	6
126. Shale, light-olive-brown to medium-gray, thin-bedded, slightly bentonitic, pyrite nodules; 1-ft-thick siltstone bed 3 ft above base; includes two silty sandy beds ------------------------------	15	0
127. Sandstone, light-gray, very fine grained, silty, thick-bedded ------------------		10
128. Shale, medium-gray to medium-dark-gray, thin- to poorly bedded, slightly bentonitic -------------------------	6	0
129. Sandstone, medium-light-gray, fine- to medium-grained, thick-bedded, crossbedded, pyrite nodules --------------	1	6
130. Shale, medium-gray to medium-dark-gray, thin- to poorly bedded, slightly carbonaceous -----------------------	6	0
131. Sandstone, light-gray, very fine to fine-grained, dark and light mineral grains, thin- to thick-bedded, crossbedded, lens-shaped beds, few pyrite nodules -	10	6
132. Shale, medium-gray, nonbedded, bentonitic -------------------------------	15	0
133. Sandstone, medium-light-gray to light-gray, very fine grained, silty, thin- to thick-bedded, pyrite nodules ---------	4	0
134. Shale, medium-gray, silty, nonbedded --	5	6
135. Sandstone, light-gray, very fine to fine-grained, thick-bedded, lens shaped ---	4	0
136. Underclay, medium-gray, nonbedded, few fossil roots ----------------------	1	0
137. Shale, dark-gray, carbonaceous, thin and evenly bedded ----------------------		2
138. Shale, medium-gray, thin and evenly bedded -------------------------------		7
139. Sandstone, light-gray, very fine grained, silty, thick-bedded, 1-ft-2-in-thick carbonaceous underclay 2 ft above base, few underclay lenses 1 ft thick with carbonaceous shale 4 ft below top, few pyrite nodules at top ----------------	21	0
140. Shale, medium-gray to light-olive-green; 1-ft-thick ironstone bed 2 in above base; 1½-ft-thick fine-grained sandstone with fossil plant and stem prints 10 ft above base; fossil roots in top of sandstone --------------------------	11	6
141. Coal, impure, shaly, sulfur, fusain, gypsum, basal part is a 4-in underclay with well-preserved fossil roots -----------		6
142. Shale, medium-gray to light-brownish-gray, thin and evenly bedded, upper 1 ft silty to sandy---------------------	6	0
143. Sandstone, medium-light-gray, very fine grained, silty, very calcareous -------	2	6
144. Underclay, medium-gray, bentonitic, poorly bedded ----------------------	6	0
145. Shale, medium-dark-gray to light-grayish-brown, slightly bony, very carbonaceous, coal fragments, fossil plant fragments and leaves ----------------		10
146. Coal, bright, impure, shaly, fusain------		3
147. Shale, dark-gray to black, very carbonaceous, abundant coal laminations; upper 8 in becomes light-grayish-brown to medium-dark-gray ---------	1	2
148. Shale, thin and evenly bedded----------	1	2
149. Sandstone, light-gray to white, very fine to fine-grained, few medium grains, thin- to thick-bedded, pyrite nodules, few crossbeds, few thin shaly lenses--	20	0
150. Shale, medium-gray, thin and evenly bedded, top part grades into bentonitic and sandy shale-------------------------	11	0
151. Sandstone, light-gray, very fine grained, silty, thin-bedded, few white volcanic ash lens-shaped interbeds up to 3 in thick, pyrite nodules ----------------	5	6
152. Shale, medium-gray to light-olive-gray, nonbedded, contains 1-ft-thick silty ironstone 8 ft above base; top grades into sandy shale -------------------	26	0
153. Sandstone, light-gray to white, fine- to medium-grained, thin- to thick-bedded, few crossbeds, few thin shale lenses, few volcanic ash layers up to 3 in thick ---------------------------	16	0
154. Underclay, medium-gray, nonbedded ---	1	6
155. Shale, light-grayish-brown, thin-bedded, few coal fragments and fossil plant fragments --------------------------		5
156. Coal, impure, bony, shaly, resin blebs --		9
157. Shale, dark-gray, thin and evenly bedded, slightly bony ----------------------		6
158. Coal, impure, shaly -------------------		3
159. Shale, medium-gray, poorly bedded-----	1	0
160. Sandstone, medium-light-gray to light-gray, very fine grained, silty, few thin shale and volcanic ash lenses; 6-in-diameter pyrite nodules 4 ft above base ------------------------------	10	0
161. Underclay, medium-gray, silty, fossil rootlets----------------------------	1	2
162. Coal, interbedded with shale and silt, fossilized flat-bladed reeds appear to have been completely charred, few coaly fragments--------------------		7
163. Underclay, light-grayish-brown to medium-gray, slightly bentonitic in medial part; top and basal 2 in thin bedded, very carbonaceous, fossil plant fragments ---------------------	2	0
164. Coal and shale interbedded-------------		7
165. Shale, medium-gray, bentonitic, top sandy	5	6

	Thickness	
	Ft	in
166. Sandstone, light-gray to white, very fine to fine-grained, thin- to thick-bedded, few thin shale and silt lenses; 1-ft-thick very iron stained siltstone 17 ft above base, few pyrite nodules	27	0
167. Shale, medium-gray to light-brownish-gray, thin-bedded to nonbedded, bentonitic; 6-in-thick coaly carbonaceous shale at top	7	6
168. Sandstone, light-gray to white, very fine to fine-grained, silty, thin-bedded	1	6
169. Underclay, medium-gray, poorly bedded, fossil rootlets	1	6
170. Shale, medium-dark-gray to light-brownish-gray, thin-bedded	1	0
171. Coal, impure, flat-bladed charred leaves, shale interbeds, fusain		6
172. Underclay, medium-gray, bentonitic	1	1
173. Coal, impure, shaly, flat-bladed charred fossil leaves	1	0
174. Underclay, medium-gray, bentonitic	1	10
175. Shale, dark-gray to dark-brown, carbonaceous, coaly fragments		4
176. Underclay, light-grayish-brown, nonbedded, top sandy	1	0
177. Sandstone, light-gray, very fine grained, silty	1	6
178. Shale, medium-gray, thin and evenly bedded; basal 2 in very carbonaceous and coaly; upper 11 in medium dark gray	1	10
179. Coal, bright		4
180. Shale, light-grayish-brown, thin and evenly bedded		8
181. Sandstone, medium-light-gray to light-gray, very fine to fine-grained, thin-bedded	2	0
182. Shale, light-grayish-brown, thin-bedded, fissile, very carbonaceous	1	6
183. Sandstone, medium-light-gray, very fine grained, silty, pyrite nodules	1	3
184. Shale, medium-gray to light-grayish-brown, thin-bedded, fissile, very carbonaceous, coal fragments	2	0
185. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	6
186. Shale, medium-gray to light-grayish-brown, very carbonaceous, fissile, top grades into sandy shale, scattered coal fragments, few thin silt and sand lenses	6	0
187. Sandstone, light-gray, very fine to fine-grained, silty, thin-bedded	2	6
188. Shale, medium-gray, slightly bentonitic, thin-bedded, poorly bedded	3	0
189. Sandstone, light-gray, very fine grained, silty, friable; upper 1 ft heavily iron stained, grades upward into siltstone	5	0
190. Shale, medium-gray, silty	4	6
191. Sandstone, medium-gray, very fine grained, heavily iron stained, thin-bedded	2	0
192. Shale, medium-gray, thin-bedded, bentonitic	6	6
193. Sandstone, light-gray, very fine to fine-grained, thin-bedded	3	0
194. Shale, medium-gray to medium-dark-gray, slightly carbonaceous, lens-shaped	4	0
195. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, few shale lenses, few pyritic nodular beds; upper 6 in heavily iron stained	19	0
196. Shale, medium-gray, fine-grained sandstone lenses up to 1 ft thick, thick-bedded, silty, slightly bentonitic; 1-ft-thick ironstone 1 ft 8 in below top; upper 2 ft light grayish brown to medium dark gray, carbonaceous	18	0
197. Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thin- to thick-bedded; 5-ft-thick shale lenses 5 ft and 15 ft above base, few iron stains, pyrite nodules	32	0
198. Shale, medium-gray, very silty, poorly bedded, few silt interbeds up to 1 ft thick, slightly bentonitic	10	0
199. Sandstone, fine-grained, dark and light mineral grains, thin- to thick-bedded, crossbedded, upper 2½ ft very calcareous	3	6
200. Shale, medium-light-gray to light-gray, thin-bedded to poorly bedded	3	0
201. Shale, medium-light-gray, fine- to medium-grained, dark and light mineral grains, thick-bedded	2	0
202. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	2	6
203. Sandstone, fine- to medium-grained, abundant dark and light mineral grains, thin-bedded to massive, few shale interbeds, crossbedded, solution cavities, slumped bedding, pyrite nodules	26	0
204. Shale, medium-gray, thin-bedded	7	0
205. Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thin- to thick-bedded, few thin shale lenses	6	0
206. Shale, medium-gray, thin and evenly bedded, few siltstone lenses up to 1 ft thick	17	0
207. Sandstone, medium-light-gray to light-gray, medium- to coarse-grained, crossbedded, massive, solution cavities, few pyrite nodules, few calcareous lenses up to 2 ft thick, few shale lenses up to 3 ft thick	25	0
208. Shale, medium-gray, thin and evenly bedded, becomes light-olive-gray upward	7	0
209. Sandstone, fine- to medium-grained, dark and light mineral grains, slump-bedded, massive, crossbedded, calcareous, iron-stained, pyrite nodules	11	0
210. Shale, medium-gray, poorly bedded, top grades into siltstone	9	0
211. Sandstone, light-gray, very fine to fine-grained, shale chips, dark and light		

		Thickness	
		Ft	in
	mineral grains, massive, few thin shale lenses up to 1 ft thick, pyrite nodules	14	0
212.	Shale, medium-gray, thin and evenly bedded	1	8
213.	Sandstone, medium-light-gray, fine-grained, thin-bedded	2	6
214.	Shale, medium-gray, thin and evenly bedded	2	6
215.	Sandstone, basal 5 ft medium-light-gray, thin-bedded, shaly, silty, very fine grained; 1-ft-thick calcareous ledge 7 ft above base; 3-ft-thick shale zone 10 ft above base; 1-ft-thick shale 3 ft below top; part of unit calcareous, crossbedded, shale chips	21	6
216.	Shale, medium-gray, poorly bedded, silty	8	0
217.	Sandstone, medium-light-gray, very fine grained, silty	1	4
218.	Shale, medium-gray to light-olive-gray, poorly bedded	6	6
219.	Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, iron-stained, pyrite nodules; few shale lenses up to 3 ft thick, medium-gray; 2-ft-thick medium-gray shale bed 17 ft above base, few siltstone interbeds; 2-ft-thick shale lens, medium-gray, 25 ft above base	35	0
220.	Shale, medium-gray, poorly bedded, contains siltstone and sandstone interbeds up to 1 ft thick	21	0
221.	Sandstone, medium-light-gray to light-gray, grades from fine- to medium-grained upward, massive, thin-bedded, pyritic nodules	6	0
222.	Shale, light-olive-gray, poorly bedded	11	6
223.	Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded	5	0
224.	Shale, light-olive-gray, thin-bedded	7	6
225.	Sandstone, very fine grained, silty, thin-bedded	2	6
226.	Shale, medium-gray to light-olive-gray	15	0
227.	Sandstone, medium-light-gray, fine- to medium-grained, thin- to thick-bedded, heavily iron stained	2	6
228.	Shale, medium-gray, poorly bedded	26	0
229.	Sandstone, light-gray, very fine to fine-grained, dark and light mineral grains, massive, crossbedded; 2-ft-thick shale lens 15 ft above base; friable; few resistant calcareous beds, iron stained	36	0
230.	Shale, medium-gray, poorly bedded	10	0
231.	Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thin-bedded to massive, shale chips at base, crossbeds, few granules, few thin shale lenses; 2-ft-thick pebbly zone 15 ft above base	35	0
232.	Shale, medium-gray, poorly bedded	10	0
233.	Sandstone, light-gray, very fine to fine-grained, massive, irregularly bedded, abundant fossil imprints, probably maple and sycamore leaves; top part of unit grades to a medium gray; dark and light mineral grains, few shale chips; moved 500 ft to south along top of unit 233 and began measuring unit 234	11	0
234.	Shale, medium-gray, thin and evenly bedded	6	0
235.	Sandstone, very fine grained, silty, thin-bedded, lens-shaped	1	0
236.	Shale, medium-gray, 1 ft of silty pyrite nodules 5 ft above base; slightly carbonaceous at top	12	0
237.	Sandstone, medium-gray to medium-light-gray, very fine grained, silty, thick-bedded, lens-shaped, pyrite nodules	1	6
238.	Shale, medium gray, poorly bedded, silty in upper 1 ft	12	6
239.	Sandstone, medium-light-gray, weathers brown, very fine to fine-grained, thin-bedded	2	0
240.	Shale, medium-gray, poorly bedded	2	6
241.	Sandstone, medium-light-gray, weathers brown, fine- to medium-grained, thin-bedded, few shale lenses up to 1 ft thick	15	0
242.	Shale, medium-gray, poorly bedded	6	0
243.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, few shale interbeds	5	0
244.	Shale, medium-gray, thin- to poorly bedded	7	0
245.	Sandstone, medium-light-gray, medium- to fine-grained, thin-bedded, few shale interbeds	3	6
246.	Shale, medium-gray, thin- to poorly bedded	6	6
247.	Sandstone, very fine to fine-grained, thin-bedded, poorly exposed	2	0
248.	Shale, medium-gray, poorly bedded	12	0
249.	Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, thick-bedded to massive, pyrite nodules, friable, irregularly bedded, crossbedded, upper half of unit becomes light gray	33	0
250.	Shale, medium-gray to medium-light-gray, silty, slightly bentonitic, poorly bedded	10	0
251.	Sandstone, very fine grained, silty, massive	2	0
252.	Shale, medium-gray, poorly bedded	4	0
253.	Siltstone, medium-gray, very fine grained sandstone, iron-stained	1	6
254.	Shale, medium-gray, thin-bedded	8	6
255.	Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thin- to thick-bedded, few siltstone lenses, pyrite nodules	15	0
256.	Shale, medium-gray, thin-bedded, few thin, silty sandstone lenses, up to 6 in thick, slightly bentonitic; 1-ft-thick carbonaceous bentonite 13 ft above base	16	0
257.	Sandstone, medium-light-gray to light-gray, weathers brown, very fine to		

		Thickness Ft	Thickness in
	medium-grained, thin- to thick-bedded, crossbedded, pyrite nodules, few silty shale lenses, fossil animal tracks	10	0
258.	Shale, medium-gray, silty to sandy, poorly bedded, becomes light-olive-gray upward	4	6
	Total measured thickness of Lance Formation	2,272	8
	Unconformity		
	Paleocene:		
	Fort Union Formation, lower member:		
259.	Sandstone, medium-light-gray, mostly fine- to medium-grained, dark and light mineral grains, thin-bedded, crossbedded, contains granule and pebble lenses 3 ft above base; shale chips, shale and silt laminations, slump bedded, triangular crossbeds; 9-ft-thick shale lenses 30 ft above base, medium gray, few calcareous lenses 50 ft above base; unit is very massive 55 ft above base, scattered pebbles ⅜ inch in diameter, solution cavities. Unit supports heavy pine and juniper growth	90	0
260.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, very calcareous upper 2 ft; basal zone friable	4	0
261.	Conglomerate, medium-light-gray, medium- to coarse-grained, shale chips, rounded quartz pebbles up to 1 inch in diameter	1	0
262.	Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, few quartz granules, crossbedded; 6-in-thick conglomerate 21 ft above base; conglomerate with 1-in quartz pebbles becomes more abundant 25 ft above base; high-angle crossbedding 50 ft above base; 60 ft above base mostly fine- to medium-grained, nonconglomeratic; bedding is very massive at 90 ft above base, contains calcareous concretions 5 to 10 inches in diameter; upper part mostly thin bedded	116	0
263.	Shale, medium-gray to medium-dark-gray, thin and evenly bedded, slightly carbonaceous	10	0
264.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded	7	0
265.	Shale, medium-gray to light-olive-gray, thin-bedded, sandy	13	0
266.	Sandstone, medium-light-green, fine- to medium-grained, thin-bedded	2	6
267.	Shale, medium-dark-gray, thin-bedded, very carbonaceous		6
268.	Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains; few pebbles in basal 3 ft and 7 ft above base; shale chips; top very friable	36	0
269.	Shale, medium-dark-gray to light-olive-gray, poorly bedded, slightly bentonitic	22	6
270.	Sandstone, very fine grained, silty, thin-bedded, heavily iron stained	1	6
271.	Shale, light-olive-green, poorly bedded, slightly bentonitic, 1 ft siltstone 9 ft above base	20	0
272.	Sandstone, medium-light-gray, very silty, shale interbeds	2	0
273.	Shale, medium-gray, thin and evenly bedded; 1-ft-thick silty sandstone lens 3 ft above base; 1-ft-thick medium-dark-gray, very fine grained, slightly carbonaceous sandstone 10 ft above base; 3-ft-thick sandstone 17 ft above base; upper 10 ft light olive gray	33	0
274.	Sandstone, light-gray, fine- to medium-grained, thin-bedded to massive crossbedded; 1-ft-thick light-grayish-brown, fissile, carbonaceous shale 1 ft above base; 1 ft of light-grayish-brown, fissile shale 3 ft above base	23	0
275.	Shale, medium-gray to light-grayish-brown, very silty and sandy, interbeds; thin bedded	13	0
276.	Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, massive, very friable, solution cavities, crossbedded, lower 2 ft of unit contains calcareous concretions; few silty shale lenses 13 ft above base; ½-in-diameter quartz pebbles, shale chips 15 ft above base; 1-ft-thick conglomerate 53 ft above base	63	0
277.	Shale, light-olive-gray to medium-gray, thin and evenly bedded	14	6
278.	Sandstone, medium-gray, very fine grained, silty, thin-bedded, iron-stained	2	0
279.	Shale, medium-gray to medium-dark-gray, thin and poorly bedded	21	0
280.	Conglomerate, rusty-brown-weathering, rounded quartz pebbles and cobbles up to 3 inches in diameter; petrified wood, chert, quartzite, shale chips, coarse-grained sandstone, interbeds and lenses, thick bedded, massive, crossbedded, upper 70 ft becomes more sandy with few scattered pebbles and medium-dark-gray shale lenses. Upper part of unit supports heavy cedar growth	155	0
281.	Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, very calcareous, basal part silty	13	0
282.	Shale, light-olive-gray to medium-gray, thin- to poorly bedded; 1-ft-thick grayish-red bed 10 ft above base	21	6
283.	Sandstone, medium-light-gray, very fine to fine-grained, silty, thin- to thick-bedded	10	0
284.	Conglomerate, medium-gray, pebbles and cobbles up to 4 inches in diameter, abundant petrified wood and agate; weathers to gravel rubble. [Note: This could be an Indian Meadows formational overlap]	25	0

	Thickness	
	Ft	in
285. Shale, light-olive-green to medium-gray, poorly bedded, becomes light-grayish-brown upward and bentonitic; upper 5 ft medium dark gray	53	0
286. Sandstone, medium-light-gray, very fine to fine-grained, few granules, thin-bedded, crossbedded; basal 1 ft contains pebbles up to ½ inch in diameter	43	0
287. Shale, medium-gray to medium-dark-gray, thin and evenly bedded; 6-in pyrite nodules 5 ft above base; 2-ft-thick bedded, fine-grained sandstone 20 ft above base; 3-ft-thick sand lens 30 ft above base, bentonitic; upper 6 in light brownish gray, very carbonaceous	54	0
288. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded	3	0
289. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, slightly bentonitic	3	0
290. Sandstone, medium-light-gray, fine-grained, thick-bedded	1	6
291. Shale, medium-gray, silty	14	0
292. Shale, dark-gray to dark-grayish-brown, thin-bedded; 1-in-thick coal lens 6 in above base; abundant coal laminations, bony	1	2
293. Shale, medium-gray, poorly bedded	4	6
294. Sandstone, very fine to fine-grained, dark and light mineral grains, thin-bedded, silty	5	6
295. Shale, medium-gray, thin and poorly bedded; 6-in pyrite nodules 2 ft above base	13	6
296. Sandstone, medium-light-gray, very fine grained, silty, contains 4-ft-thick silty shale 4 ft above base, medium-gray	16	0
297. Shale, medium-gray, poorly bedded, silty, upper 2 ft light-olive-green	6	6
298. Conglomerate, medium-light-gray, pebbles up to 1 inch in diameter, lens-shaped beds, crossbedded, grades upward to fine-grained sandstone; bedding slightly disrupted 25 ft above base	33	0
Total measured thickness of lower member of Fort Union	971	6
Fort Union Formation, Shotgun Member:		
299. Covered, probably shale	25	0
300. Shale, medium-dark-gray, thin-bedded, top part grades to light-olive-green	10	0
301. Sandstone, medium-light-gray, very fine to fine-grained, silty, thin-bedded	10	0
302. Shale, light-olive to medium-gray, poorly bedded, few silt and sand laminations	25	0
303. Sandstone, medium-light-gray, very fine grained, silty		8
304. Shale, light-olive-gray, upper 1 ft medium-dark-gray, thin and poorly bedded, bentonitic	11	0
305. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded, calcareous	1	0
306. Shale, light-grayish-brown to medium-gray, thin- to poorly bedded, upper 3 ft. light-olive-gray	25	0
307. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, few shale chips	6	0
308. Shale, medium-gray, silty, thin-bedded	4	0
309. Sandstone, medium-light-gray, very fine grained, thin-bedded, very calcareous; 6-in-thick light-gray shale lens 6 in below top	2	6
310. Shale, medium-gray, poorly bedded, upper 1 ft light-olive-gray, thin-bedded	38	0
311. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded	1	6
312. Shale, medium-gray to light-grayish-brown to dark-gray, slightly carbonaceous	4	6
313. Sandstone, medium-gray, very silty shale	2	0
314. Underclay, medium-gray to light-olive-gray, poorly bedded	1	6
315. Shale, light-grayish-brown, thin-bedded, abundant coal fragments, fossil rootlets		3
316. Shale, light-greenish-gray, thin-bedded; 3-in-thick light-grayish-brown carbonaceous zone 1½ ft above base; unit partly covered	17	0
317. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, lens-shaped beds	2	0
318. Shale, medium-gray, poorly bedded, few siltstone lenses	7	0
319. Sandstone, medium-light-gray, silty, thick-bedded, fossil roots in top portion	1	8
320. Shale, medium-gray, poorly bedded	5	0
321. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	10
322. Shale, medium-gray, thin-bedded	5	0
323. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, silty, thin-bedded to massive, crossbedded, pyrite nodules, few medium-gray shale lenses, upper 10 ft light-gray, fine- to medium-grained	20	0
324. Shale, medium-gray, upper 5 ft light-greenish-gray, nonbedded	15	0
325. Sandstone, medium-light-gray to light-green, very fine to fine-grained, silty, thin-bedded	3	0
326. Shale, light-olive-green to medium-gray, thin-bedded, few thin silty beds, slightly bentonitic	55	0
327. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, contains few shale interbeds	5	0
328. Shale, medium-gray to light-olive-gray, nonbedded	2	0

		Thickness	
		Ft	in
329.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	2	6
330.	Shale, light-olive-green, poorly bedded	6	0
331.	Sandstone, medium-light-brown, weathered brown, very fine grained, silty, thin-bedded, calcareous	4	0
332.	Shale, medium-gray, silty, poorly bedded; 6-in-thick fine-grained sandstone bed 10 ft above base; 4-in-thick fine-grained, silty sandstone bed 21 ft above base; 1-ft-thick fine-grained sandstone bed 48 ft above base; upper 1 ft light grayish brown, thin bedded	60	0
333.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded	3	0
334.	Shale, medium-gray, poorly bedded	7	6
335.	Siltstone, very fine grained, very sandy, grades sandy upward, few coal laminations	10	0
336.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	5	0
337.	Shale, light-olive-gray, thin-bedded, silty, contains 6-in-thick siltstone laminations 15 ft above base; 4-in-thick sandstone lens 32 ft above base	45	0
338.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded	4	0
339.	Shale, medium-gray to light-olive-gray, nonbedded, partly covered	30	0
340.	Sandstone, medium-light-gray, very fine to fine-grained, silty, few shale interbeds, crossbedded, slightly calcareous, upper 5 ft light-gray	13	0
341.	Shale, medium-gray to light-olive-green, slightly bentonitic, nonbedded	22	0
342.	Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, friable	6	0
343.	Shale, light-olive-gray, bentonitic, poorly bedded; 2-ft-thick sandstone bed 7 ft below top	30	0
344.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	5	0
345.	Shale, light-olive-gray, nonbedded	5	0
346.	Sandstone, medium-gray to light-olive-gray, very fine-grained, silty	2	0
347.	Shale, light-olive-green, silty, poorly bedded	37	0
348.	Sandstone, medium-light-gray, very fine grained, silty, crossbedded, thin-bedded, slump-bedded in basal 5 ft, calcareous	10	0
349.	Shale, light-olive-gray, poorly bedded	33	0
350.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, crossbedded	4	0
351.	Shale, light-olive-green, grades medium-gray, poorly bedded; 5-ft-thick bentonitic zone 10 ft above base; 1-ft-thick siltstone 27 ft above base	37	0
352.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, crossbedded	12	0
353.	Shale, medium-gray, nonbedded, silty; 1-ft 1-in-thick layer of cone-in-cone structure 5 ft above base	24	0
354.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	7	0
355.	Shale, upper 2 ft grayish-brown, thin-bedded, very carbonaceous	7	0
356.	Sandstone, very fine grained, silty, thin-bedded	12	0
357.	Shale, medium-gray, thin-bedded, silty, upper 7 ft light olive gray, very silty, sandy	17	0
358.	Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, thin- to thick-bedded, crossbedded, silty, becomes massive upward, slightly calcareous	6	0
359.	Shale, medium-dark-gray, bentonitic, becomes light-olive-gray in top 5 ft	12	6
360.	Sandstone, medium-gray, very fine grained, dark and light mineral grains, silty	1	0
361.	Shale, light-olive-gray to medium-dark-gray	5	0
362.	Sandstone, medium-light-gray, fine- to medium-gray, very fine grained at top, few granules at base, thin-bedded, crossbedded; upper 2 ft calcareous, thin bedded, contorted in central part of syncline [Note: Location in center of syncline]	6	0
363.	Shale, medium-dark-gray to light-olive-gray at top	12	0
364.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, crossbedded, lens-shaped beds	3	0
365.	Shale, light-olive-gray, poorly bedded	17	0
366.	Sandstone, medium-gray, very fine grained, very silty, thin-bedded	2	6
367.	Shale, light-olive-gray, silty, poorly bedded	19	0
368.	Siltstone, iron-stained, poorly bedded	1	0
369.	Shale, light-olive-gray, slightly bentonitic, poorly bedded	10+	
	Alluvial Cover		
	Total measured thickness of Shotgun Member of Fort Union Formation	862	5
	Total measured thickness of Fort Union Formation	1,833	11

Measured section 4: Meeteetse Formation (Part)

Location: Eagle Point Quadrangle, Wyoming (7.5 min)
Start: NE–NW–NW sec. 20, T. 6 N., R. 1 E. Presented from oldest to youngest
End: NE–NE–NW sec. 20, T. 6 N., R. 1 E.
Described by: J.F. Windolph, Jr.
Strike 170°, Dip 23° NE.

Upper Cretaceous:

Meeteetse Formation (partial section):

	Thickness	
	Ft.	In.
1. Sandstone, medium-light-gray, very fine to fine-grained, massive, abundant carbonaceous material, calcareous concretions up to 8 ft in diameter; pyrite nodules; basal portion covered by alluvium; top grades into unit 2	17	6
2. Siltstone, medium-light-gray, very fine grained, thin-bedded, very sandy	4	0
3. Shale, medium-gray, thin and evenly bedded, silty, sandy, pyrite nodules	2	0
4. Sandstone, medium-light-gray, very fine grained, silty	2	6
5. Shale, medium-dark-gray, very fine grained, very sandy, slightly carbonaceous		9
6. Sandstone, medium-light-gray; basal 2 ft very fine-grained, silty; upper part fine to medium grained; few shale chips, massive, few pyrite nodules, few calcite-rich nodules up to 4 ft in diameter	8	0
7. Shale, medium-gray, poorly bedded	3	0
8. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, few fossil roots, few pyrite nodules, pebbles at base	2	0
9. Shale, medium-gray, poorly bedded	1	2
10. Sandstone, medium-light-gray, very fine grained, silty	1	6
11. Shale, medium-gray, thin and evenly bedded	1	6
12. Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, few fossil roots	1	3
13. Shale, medium-gray, thin and evenly bedded		5
14. Sandstone, medium-gray, very fine grained, thin-bedded, silty, shaly	2	0
15. Underclay, medium-gray, nonbedded	2	9
16. Shale, medium-dark-gray, carbonaceous, fossil plant fragments		2
17. Shale, medium-gray, thin and evenly bedded, few scattered calcareous siltstone interbeds	2	0
18. Sandstone, medium-light-gray, very fine to fine-grained, basal 2 ft friable; thin-bedded with ripples; upper 3 ft very calcareous; base gradational into unit 17	5	0
19. Sandstone, medium-light-gray, very fine grained, massive, silty, friable	3	0
20. Shale, medium-gray, thin and evenly bedded	1	6
21. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	2	6
22. Shale, medium-gray, basal 1 ft very silty and thin-bedded, upper part poorly bedded	9	6
23. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, very calcareous, crossbedded	3	0
24. Siltstone, medium-light-gray, very fine grained, silty, massive	3	0
25. Shale, medium-gray, poorly bedded, carbonaceous		10
26. Siltstone, medium-gray, thin and evenly bedded, very calcareous	1	4
27. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	3	0
28. Shale, medium-gray to medium-dark-gray, carbonaceous, upper 6 in medium-gray	2	8
29. Shale, medium-gray, very silty, unevenly bedded	2	6
30. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	4	0
31. Shale, medium-gray, thin- to poorly bedded	2	8
32. Underclay, medium-gray, nonbedded, fossil rootlets	2	6
33. Coal, impure, bony, shaly		7
34. Coal, bright to dull, resin blebs, few bony streaks, cleats 70° at vertical, and 155° at 65° SW.		10
35. Sandstone, medium-gray, very fine grained, silty, thin-bedded, basal 4 in medium-gray, carbonaceous shale laminations	1	10
36. Underclay, medium-gray, poorly bedded, upper 1 ft light-brownish-gray, very carbonaceous, fossil rootlets	3	0
37. Coal, bright resin blebs, fine- to medium-cleats, upper 6 in slightly bony, gypsum crystals (Woodruff and Winchester, 1912, pl. L, no. 61)	3	8
38. Bone, shaly	1	0
39. Sandstone, medium-light-gray, very fine grained, massive, silty, friable, basal 9 in medium-gray shale, two thin calcareous beds	13	0
40. Bentonite, medium-gray to medium-dark-gray, nonbedded, a few gypsum crystals, 1-ft-thick carbonaceous zones	13	10
41. Sandstone, medium-light-gray, very fine grained, very calcareous, thin- to thick-bedded, lens-shaped	2	0
42. Shale, medium-gray, thin and evenly bedded, silty		4
43. Sandstone, medium-light-gray, very fine grained, silty	2	0
44. Bentonite, medium- to medium-dark-gray, soft	2	4
45. Siltstone, medium-gray, very fine grained, sandstone	1	8
46. Bentonite, medium-dark-gray, very fine grained, gypsum crystals		8
47. Shale, light-grayish-brown, very carbonaceous, contains bentonite particles		8
48. Underclay, medium-gray, fossil roots	2	4
49. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	3
50. Shale, light-grayish-brown, very carbonaceous, thin and evenly bedded, few fossil roots and plant fragments	1	8
51. Coal, bright, resin blebs, slightly bony		3
52. Underclay, medium-gray, abundant fossil roots, few silty to sandy lenses, slightly carbonaceous in upper 2 in	4	0

	Thickness	
	Ft	in
53. Sandstone, medium-light-gray, fine- to medium-grained, crossbedded, thin-bedded, calcareous concretions up to 2 ft in diameter, basal 2 ft very silty with pyrite nodules	7	6
54. Underclay, medium-gray, fossil rootlets	5	0
55. Shale, light-grayish-brown to medium-dark-gray, thin-bedded		10
56. Shale, medium-gray to medium-dark-gray, poorly bedded, few siltstone lenses up to 2 in thick	2	0
57. Shale, light-grayish-brown to medium-dark-gray, carbonaceous, thin- to poorly bedded, silty	1	2
58. Shale, medium-gray to light-olive-gray	1	6
59. Sandstone, medium-light-gray, very fine grained, silty, very thin bedded, fossil roots in upper 8 in	4	4
60. Underclay, medium-gray, fossil rootlets		2
61. Coal, bright, gypsum crystals, resin blebs	1	0
62. Coal, impure, bony, upper 4 in detrital, gypsum crystals, resin blebs		11
63. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, very calcareous	12	0
64. Underclay, medium-gray, fossil roots	3	0
65. Coal, bright attritus		1
66. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, very carbonaceous, fossil plant fragments		6
67. Shale, medium-gray, thin and evenly bedded		3
68. Sandstone, medium-light-gray, very fine to fine- to medium-grained, massive	12	6
69. Underclay, medium-gray, fossil rootlets, upper 2 in very carbonaceous, light-grayish-brown	1	3
70. Coal, bright, resin blebs		10
71. Bone		5
72. Shale, medium-gray, poorly bedded		8
73. Sandstone, medium-light-gray, very fine to fine- to medium-grained, massive, solution cavities, calcareous concretions up to 10 ft in diameter	12	0
74. Underclay, medium-gray, rootlets	1	6
75. Coal, impure, shaly		5
76. Shale, medium-gray, poorly bedded	1	0
77. Sandstone, medium-light-gray, very fine-grained, thin-bedded, silty, shaly	2	8
78. Shale, medium-gray, poorly bedded, 6-in-thick siltstone layer 5 ft above base	7	0
79. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, very calcareous	1	6
80. Shale, medium-gray, thin and evenly bedded, silty	2	0
81. Underclay, medium-gray, fossil roots	2	6
82. Shale, medium-dark-gray to dark-gray, very carbonaceous, fossil plant fragments	2	2
83. Shale, medium-gray, poorly bedded	1	4
84. Shale, medium-dark-gray to dark-gray, very carbonaceous, few fossil root and plant fragments		9
Base of Welton coal bed		
85. Coal weathered, bright to dull, fusain, few scattered bony layers, partially covered (Woodruff and Winchester, 1912, pl. L, no. 66)	11	6
86. Bone, shaly, bright		4
87. Coal, bright		8
88. Underclay, medium-gray, shaly, silty, abundant fossil rootlets		5
89. Coal, bright to dull fusain, medium cleats, 170° at 67° SW., and 80° at vertical	1	7
Top of Welton coal bed		
90. Siltstone, medium-gray to light-grayish-brown, very carbonaceous, fossil plant and coal fragments	1	2
91. Shale, medium-gray, basal 4 in medium-dark-gray, carbonaceous, thin and evenly bedded; upper 1 ft silty	5	2
92. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, crossbedded, few scattered shale lenses; thin calcareous zones; upper 3 ft very calcareous	12	6
93. Shale, medium-gray, poorly bedded	6	0
94. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, very calcareous; basal 4 in very silty, calcareous	2	0
Total measured thickness of partial Meeteetse section	287	2

Measured section 5: Cody Shale and Mesaverde Formation

Location: Maverick Spring Quadrangle, Wyoming (7.5 min)

Start: NW–SE–SE sec. 7, T. 5 N., R. 1 W. Presented from oldest to youngest

End: SE–NE–NW sec. 18, T. 5 N., R. 2 W.

Described by: N.L. Hickling

Strike 135°, Dip 85° NE.

	Thickness	
Upper Cretaceous:	Ft	In
Cody Shale:		
1. Shale, medium-dark-gray, thin and evenly bedded, contains interbeds of very thin bedded sandstone, light- to medium-gray, very fine grained, scattered, dark and light mineral grains, abundant mica flakes, very calcareous; sandstone interbeds are parallel bedded, convoluted, and contain low-angle crossbeds	181	0
Total measured thickness of Cody Shale	181	0

	Thickness	
	Ft	in
Mesaverde Formation:		
2. Sandstone, mostly light-gray, very fine to fine-grained, scattered iron-stained, solution cavities, very calcareous, thick-bedded to massive; sandstone in basal 1 ft, light- to dark-gray, fine-grained, sparsely crossbedded, massive, fossil shells in lower half of unit, few scattered pyrite nodules and shale fragments. Contact with underlying Cody Shale is sharp	175	0
3. Sandstone, medium-gray, fine-grained, thin to thick and irregularly bedded, iron-rich calcareous resistant ledges about 1 ft thick at base and top	44	0
4. Shale, medium-gray, thin and evenly bedded	11	0
5. Sandstone, medium-gray, very fine grained, thin-bedded, nonresistant, silty, iron-stained	6	0
Base of Maverick Spring coal zone		
6. Shale and coal: Shale—medium-gray, thin and evenly bedded, carbonaceous; coal—1-in-thick, bright	17	0
7. Sandstone, medium-gray, fine-grained, nonresistant, few iron stains	14	6
8. Shale and coal: Shale—medium-gray, thin and evenly bedded, upper 1 ft carbonaceous; coal—1-ft-3-in-thick, bright	5	0
9. Sandstone, medium-gray, fine-grained, nonresistant	3	6
10. Shale and coal: Shale—thin and evenly bedded, sandy in top 6 in; coal—8-in-thick, bright	3	6
11. Sandstone, light- to medium-gray, nonresistant	2	0
12. Underclay, highly weathered, fossil roots	3	0
13. Shale, tonstein, and coal: Shale—carbonaceous, medium-brownish-gray, thin and evenly bedded; coal—2-ft-9-in-thick, bright; tonstein—1½-in-thick, 5 in below top of coal	7	0
Top of Maverick Spring coal zone		
14. Sandstone, medium-gray, fine-grained, iron-stained, thin and irregularly bedded, very calcareous	59	0
15. Shale and coal: Shale—medium-gray, thin and evenly bedded, sandy in basal 2 ft; coal—(3 beds) 4-in-thick, 6 ft above base; 10-in-thick, 13 ft above base; and 2-in-thick at top of unit; bright	22	6
16. Sandstone, medium-gray, fine-grained, thin- to thick-bedded, iron-stained, very calcareous, resistant, top 3 ft thin and irregularly bedded, remainder of unit highly weathered, nonresistant	17	6
17. Shale, medium-gray, thin and evenly bedded, very carbonaceous in upper 1½ ft	13	0
18. Sandstone, light-gray, very fine grained, silty, thin to thick and irregularly bedded, iron-stained, resistant, very calcareous	13	0
19. Shale, medium-gray, thin and evenly bedded, silty	5	6
20. Underclay, highly weathered, fossil plant fragments	1	2
21. Coal, finely cleated, mostly bright, few impure laminations, cleats, 35° at 85° NW., and 140° at 80° NE.	1	0
22. Sandstone, light-medium-gray, fine-grained		5
23. Coal, highly weathered		2
24. Coal, impure, few bright laminations		1½
25. Shale, medium-gray, thin and evenly bedded		11
26. Sandstone and limestone: Sandstone—medium-light-gray, very fine grained, thin- to thick-bedded, silty, iron-stained, resistant, calcareous; limestone—medium-gray, silty in basal 2 ft	4	8
27. Shale, medium-gray, thin and evenly bedded, upper 2 in grades to carbonaceous shale	3	1
28. Coal, impure		2½
29. Shale, light-medium-gray, carbonaceous		1
30. Coal, impure		1
31. Shale, medium-gray, thin and evenly bedded		8
32. Underclay, carbonaceous, highly weathered	1	2
33. Shale, medium-brownish-gray, thin and irregularly bedded, very carbonaceous, 1-in-thick impure coal lens at top	1	4
34. Underclay, highly weathered		6
35. Coal, few scattered impure laminations		5
36. Coal, bright, scattered resin blebs, finely cleated		4
37. Shale, medium-gray, thin and evenly bedded, upper half of unit interbedded shale and siltstone	11	3
38. Siltstone, light-gray, thin and irregularly bedded, sandy, iron-stained, very resistant, very calcareous in upper 8 in	3	6
39. Shale and limestone: Shale—medium-gray, thin and evenly bedded; limestone—medium-gray, silty in basal 2 ft	3	6
40. Underclay, medium-brownish-gray, few scattered fossil plant fragments, fossil rootlets	1	0
41. Coal, bright, slightly impure		2
42. Coal, mostly bright, finely cleated, few impure laminations		2
43. Shale, medium-gray, carbonaceous in upper 1 in		3
44. Coal, bright, few impure laminations		2
45. Shale, medium-gray, thin and evenly bedded		4
46. Sandstone, medium-light-gray, very fine-grained, silty, thin to thick and irregularly bedded, resistant, iron-stained, scattered pyrite nodules up to ¼ inch in diameter, calcareous	5	4
47. Shale, medium-gray, thin and evenly bedded	1	8

	Thickness	
	Ft	in
48. Sandstone, light-gray, fine-grained, scattered light and dark mineral grains, crossbedded, scattered pyrite nodules up to ¼ inch in diameter	5	10
49. Shale, medium brownish-gray, carbonaceous		4
50. Shale, medium-gray, thin and evenly bedded, lower 2 in thin-bedded siltstone, laminated, calcareous	9	8
51. Sandstone, medium-light-gray, fine-grained, thick-bedded, scattered pyrite nodules	7	6
52. Shale, medium-gray, thin and evenly bedded	6	4
53. Sandstone, light-gray, fine-grained, thin- to thick-bedded, resistant in lower 4 in, iron-stained, scattered pyrite nodules, calcareous	1	1
54. Shale, medium-gray, thin and evenly bedded, top 10 in carbonaceous	3	0
55. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, thin to thick and irregularly bedded, locally iron-stained, scattered pyrite nodules	13	6
56. Shale and coal: Shale—medium-gray, thin and evenly bedded, silty, few siltstone laminations; coal—2 ft ½ in, bright, 2 ft below top	31	0
57. Sandstone, medium-gray, fine-grained, thin- to thick-bedded, resistant, scattered pyrite nodules	19	8
58. Sandstone, light- to medium-gray, fine- to medium-grained, thin to thick and irregularly bedded, crossbedded, resistant, iron-stained, calcareous	33	8
59. Shale, medium-gray, thin and evenly bedded	7	0
60. Sandstone, light-gray, fine-grained, light and dark mineral grains, crossbedded, solution cavities, resistant	15	8
61. Shale, medium-gray, thin and evenly bedded	3	0
62. Sandstone, light- to medium-gray, fine-grained, thin- to thick-bedded, resistant	1	4
63. Shale and limestone: Shale—medium-gray, thin and evenly bedded; limestone—medium-gray, 2-ft-thick	5	0
64. Siltstone, light-gray, thin and irregularly bedded, resistant, noncalcareous	1	0
65. Shale, medium-gray, thin and evenly bedded	3	10
66. Underclay, medium-brownish-gray, much organic matter		4
Unnamed coal bed		
67. Coal, bony, bright laminations 30 percent, impure, dull, 70 percent; not resource quality	2	6
Top of unnamed coal bed		
68. Sandstone, light-gray, very fine grained, gray mineral grains, crossbedded, massive, solution cavities, scattered pyrite nodules	5	6
69. Shale, medium-gray, thin and irregularly bedded	4	10
70. Siltstone, medium-gray, thick and irregularly bedded, very calcareous	3	0
71. Shale, medium-gray, thin and evenly bedded, thin siltstone laminations, carbonaceous in top 5 in	3	2
72. Sandstone, medium-light-gray, fine-grained, iron-stained, resistant, crossbedded, scattered pyrite nodules; top 50 ft calcareous, resistant interbeds of sandstone, calcareous, iron-stained shale	138	0
73. Sandstone, fine-grained, iron-stained, resistant, calcareous, thick and irregularly bedded	36	0
74. Shale, medium-gray, sandy	8	2
75. Shale, medium-brownish-gray, carbonaceous, fossil plant material	1	4
76. Coal, impure		2
77. Shale, medium-brownish-gray, carbonaceous		3
78. Coal, fine cleats, impure		7
79. Shale, medium-brownish-gray, carbonaceous		2
80. Shale, medium-gray, sandy, thin and irregularly bedded	26	10
81. Siltstone, medium-gray, iron-stained, very calcareous, irregularly bedded	6	0
82. Shale, medium-gray, thin and irregularly to regularly bedded, few siltstone laminations	33	0
83. Sandstone, very fine grained, silty, thin and irregularly bedded, resistant, very calcareous	14	0
84. Shale, thin and irregularly bedded, sandy, few sandstone laminations	43	6
85. Sandstone, medium-gray, fine-grained, iron-stained, few resistant ledges in middle part of unit, very calcareous	33	0
86. Shale, medium-gray, sandy, thin and irregularly bedded	38	0
87. Sandstone, medium-gray, fine-grained, very calcareous, crossbedded, resistant in middle part of unit, solution cavities	69	0
88. Shale, gray, thin and evenly bedded	2	10
89. Shale, thin and irregularly bedded, few thin carbonaceous laminations	18	8
90. Siltstone, medium-gray, sandy, thin and irregularly bedded, nonresistant, few calcareous resistant laminations	28	8
91. Shale, thin-bedded, sandy, carbonaceous in basal 1½ ft	10	6
92. Sandstone, medium-gray, fine-grained, iron-stained, calcareous	1	6
93. Shale, gray, thin and evenly bedded	4	2
94. Sandstone, very fine to fine-grained, iron-stained, calcareous, thin- to thick-bedded, solution cavities	50	4
95. Shale, medium-gray, fine-grained, very sandy, scattered calcareous siltstone and sandstone laminations	50	0

	Thickness	
	Ft	in
96. Sandstone, fine-grained, fossil plant material, solution cavities, iron-stained; calcareous, resistant ledges	9	2
97. Shale, medium-gray, thin-bedded, silty, thin carbonaceous laminations	13	4
98. Sandstone, deeply weathered, silty	15	10
99. Shale, medium-gray, thin and irregularly bedded	4	2
100. Sandstone, medium-gray, fine-grained, very calcareous, crossbedded, thick and irregularly bedded to massive	20	10
101. Shale, thin and evenly bedded, silty laminations, carbonaceous zone 1½ ft thick at base of unit	12	10
102. Siltstone, medium-gray, deeply weathered, thin and resistant beds	9	6
103. Shale, thin and evenly bedded, carbonaceous	3	0
104. Sandstone, lower 7 ft resistant, light-gray, fine- to medium-grained, thin and irregularly bedded; remainder deeply eroded, silty, nonresistant, mostly covered	27	6
105. Shale, medium-gray, thin and evenly bedded	2	4
106. Sandstone, medium-gray, fine-grained, silty, very calcareous, middle part of unit iron-stained, resistant, thin- to thick-bedded, largely covered, nonresistant	74	8
107. Shale, medium-gray, thin and evenly bedded	9	4
108. Sandstone, fine-grained, iron-stained, resistant, solution cavities	2	10
109. Shale, medium-gray, thin and evenly bedded	6	6
110. Sandstone, light- to medium-gray, fine-grained, silty, solution cavities, resistant, very calcareous	16	2
111. Shale, medium-gray, thin and irregularly bedded	11	2
112. Sandstone, light- to medium-gray, fine-grained, thin to thick and irregularly bedded, crossbedded, resistant	10	11
113. Shale, medium-gray, irregularly bedded	3	8
114. Sandstone, light- to medium-gray, fine- to medium-grained, thick-bedded to massive, scattered pyrite nodules, solution cavities, crossbedded	23	10
115. Shale, medium-gray, thin-bedded	9	0
116. Sandstone, light- to medium-gray, thick-bedded to massive, very fine to fine-grained, scattered pyrite nodules, very calcareous, three resistant ledges 1½ ft thick above nonresistant parts of unit, solution cavities	49	6
117. Shale, medium-gray, thin and evenly bedded	6	4
118. Sandstone, very fine to fine-grained, thin- to thick-bedded, calcareous, three resistant calcareous ledges above thin-bedded, noncalcareous part of unit	70	0
119. Shale, medium-gray, thin-bedded	16	6
120. Sandstone, light-medium-gray, fine-grained, light and dark mineral grains, thin- to thick-bedded, slightly resistant	8	0
121. Shale, medium-gray, thin and irregularly bedded	9	5
122. Siltstone, very calcareous, resistant, iron-stained	7	2½
123. Shale, medium-gray, thin-bedded	2	6
124. Sandstone, light-medium-gray, fine-grained, thin irregularly bedded, solution cavities	2	5
125. Underclay, fossil roots, upper 5 in includes carbonaceous fragments	1	3½
126. Shale, medium-gray, thin and evenly bedded		3
127. Shale, thin and evenly bedded, carbonaceous in lower 1 ft 3 in	1	7
128. Sandstone, light-medium-gray, light and dark mineral grains, thin to thick and irregularly bedded, solution cavities, few ledges of calcareous siltstone	17	0
129. Shale, medium-gray, thin-bedded	6	5
130. Sandstone, medium-gray, iron-stained, pyrite grains, dark mineral grains, very calcareous in bottom third of unit, thin to thick and irregularly bedded in upper 14 ft, slightly resistant	21	0
131. Shale, medium-gray, thin-bedded	8	2½
132. Sandstone, medium-gray, fine-grained, iron-stained, scattered pyrite nodules, thin and irregularly bedded, calcareous, resistant	4	0
133. Shale, medium-gray, silty, siltstone laminations and lenses	4	11
134. Siltstone, medium-gray, sandy, very calcareous, iron-stained, thin-bedded, resistant	3	6
135. Shale, medium-gray, thin and evenly bedded	3	7
136. Siltstone, gray, thick and irregularly bedded, sandy	9	0
137. Sandstone, medium-gray, very fine to fine-grained, calcareous, iron-stained, solution cavities, massive-bedded	2	5
138. Shale, medium-gray, thin-bedded, silty	12	2½
139. Sandstone, light-medium-gray, fine-grained, fossil plant fragments, massive to thick-bedded, solution cavities, calcareous, resistant ledges	8	11
140. Shale, medium-gray, thin-bedded, few siltstone laminations, slightly carbonaceous	25	9½
141. Sandstone, fine-grained, light and dark mineral grains, thin to thick and irregularly bedded, calcareous-rich resistant ledges	13	11
142. Shale, medium-gray, thin and evenly bedded, carbonaceous zone, siltstone laminations 1 ft above base	16	2½
143. Siltstone, medium-gray, thin and irregularly bedded, very calcareous	4	7
144. Shale, medium-gray, thin and evenly bedded	2	5

	Thickness	
	Ft	in
145. Sandstone, medium-gray, very fine grained, very calcareous, thin-bedded	4	11
146. Shale, medium-gray to light-greenish-gray, silty, thin-bedded	4	5
147. Sandstone, very fine to fine-grained, thin and irregularly bedded	3	0
148. Shale, medium-gray to grayish-red, thin and evenly bedded	3	5
149. Sandstone, light-gray, very fine grained, thin and irregularly bedded, some calcareous-rich resistant ledges	23	7
150. Shale, medium-gray, thin and evenly bedded	9	0
151. Sandstone, medium-gray, iron-stained, medium-grained, dark and light mineral grains, very calcareous, scattered pyrite nodules, thin to thick and irregularly bedded	13	0
Total measured thickness of main body of Mesaverde Formation	1,955	1
Unconformity		
White sandstone member:		
152. Sandstone, light-gray, medium-grained, light and dark mineral grains, thin and irregularly bedded, calcareous	24	5
153. Sandstone, light-gray, massive, fine- to medium-grained, very clean, well-sorted light and dark mineral grains, scattered pyrite nodules, solution cavities	330	0
Total measured thickness of white sandstone member	354	5
Total measured thickness of Mesa verde Formation	2,309	6

Measured section 6: Mesaverde Formation and Indian Meadows Formation

Location: Maverick Spring, Wyoming (7.5 min)
Start: SW–SW–NW sec. 18, T. 5 N., R. 2 W. Presented from oldest to youngest
End: NE–SE–NW sec. 18, T. 5 N., R. 2 W.
Described by: N.L. Hickling
Strike 310°, Dip 40° NE.

Upper Cretaceous:	Thickness	
White sandstone member of Mesaverde Formation:	Ft	In
1. Sandstone, light-gray, medium- to coarse-grained, dark and light mineral grains, scattered pyrite nodules, thick-bedded to massive	50	0
2. Shale, medium-gray, thin and evenly bedded	6	2½
3. Shale, carbonaceous, thin and irregularly bedded, upper 1 in medium-brownish-gray		7
4. Sandstone, light-gray, thin and irregularly bedded, fine-grained		5
5. Shale, medium-brownish-gray, carbonaceous, thin and evenly bedded, olive-gray in bottom 7 in	2	0
6. Siltstone, dark-gray, thin and irregularly bedded, non-calcareous in lower half of unit, upper half light gray	1	7
7. Shale, medium-dark-gray in bottom third, medium-brownish-gray in middle third, medium-gray in upper third, thin and evenly bedded	2	0
8. Sandstone, light-gray, massive, medium- to dark-gray streaks of heavy minerals, thick-bedded, crossbedded, scattered pyrite nodules, iron-stained	32	0
9. Shale, medium-gray, thin and evenly bedded, few sandstone lenses	2	0
10. Sandstone, light-gray, medium- to coarse-grained, heavy mineral grains, includes two shale lenses, medium-gray, thin and evenly bedded, 2-ft-thick	45	0
11. Sandstone, very light gray, light and dark mineral grains, thin to thick and irregularly bedded, scattered pyrite nodules, slightly iron stained	39	0
12. Sandstone, light-gray, medium- to coarse-grained, light and dark mineral grains, solution cavities, thick-bedded to massive, crossbedded	169	0
Total measured thickness of white sandstone member	349	9½
Indian Meadows Formation:		
Unconformably overlies Mesaverde		
13. Conglomerate, medium-coarse-grained sandstone, light and dark mineral grains, brown ferruginous cement. Interbeds of very coarse detrital material and coarse brown sandstone. Upper 30 ft includes cobbles, and pebbles ½ to 3 inches in diameter	46	0
Total measured thickness of Indian Meadows Formation	46	0

End of section

Measured section 7: Mesaverde Formation

Location: Maverick Spring Quadrangle, Wyoming (7.5 min)
Start: SE–SW–NW sec. 19, T. 5 N., R. 1 W. Presented from oldest to youngest
End: NW–NE–NE sec. 19, T. 5 N., R. 1 W.
Described by: J.F. Windolph, Jr.
Strike 130°, Dip 30° NE.

Upper Cretaceous:	Thickness	
Mesaverde Formation:	Ft	In
1. Sandstone, medium-light-gray, very fine grained, thick-bedded, crossbedded, silty	4+	
2. Shale, grayish-red, weathered light-yellowish-brown, thin and evenly bedded	4	6

	Thickness	
	Ft	in
3. Sandstone, medium-light-gray, weathered light-greenish-gray, very fine grained, thick-bedded, crossbedded, silty	15	0
4. Shale, medium-dark-gray, basal 1 ft grayish-red, thin and evenly bedded, becomes poorly bedded toward top	18	0
5. Underclay, medium-gray, nonbedded, scattered fossil rootlets	2	6
6. Shale, dark-gray, thin-bedded, carbonaceous, abundant coal and carbonaceous fragments, scattered resin blebs and gypsum crystals		10
7. Shale, medium-gray, thin and evenly bedded, few fossil plant fragments		7
8. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, silty	3	0
9. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, contains siltstone and sandstone interbeds, scattered coal and carbonaceous laminations in basal 4 in	3	0
10. Sandstone, medium-light-gray, very fine grained, thick-bedded, crossbedded	2	6
11. Shale, light-olive-gray, poorly bedded, silty, upper 10 in medium-gray and thin-bedded	2	9
12. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	4
13. Shale, medium-gray, grades from thin-bedded at base to nonbedded at top, few fossil rootlets in top 2 in	1	0
14. Shale, dark-grayish-brown, thin-bedded, very carbonaceous, silty, abundant coal fragments		7
15. Coal, bright, impure, with few shale laminations		5
16. Shale, medium-gray, thin and evenly bedded, slightly carbonaceous	1	4
17. Sandstone, medium-light-gray, very fine grained, thin and irregulary bedded, silty, upper 1 ft very shaly to silty	2	0
18. Limestone, medium-gray, very calcareous, brittle, fractured	1	1
19. Shale, medium-gray, thin- to poorly bedded	2	2
20. Sandstone, medium-light-gray, very fine grained, thin- bedded at base to thick-bedded at top, silty	1	10
21. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, upper 6 in very fissile	1	10
22. Sandstone, medium-light-gray, very fine grained, silty, grades from thick-bedded at base to thin-bedded at top	2	0
23. Shale, medium-gray to medium-dark-gray in basal 1 ft; thin and evenly bedded; top 1 ft slightly silty	3	8
24. Limestone, medium-gray, brittle, fractured	1	10
25. Shale, medium-gray, medium-dark-gray in basal 1 ft, thin and evenly bedded, very silty and sandy	4	4
26. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, crossbedded, convolutions, very silty	5	0
27. Shale, medium-gray to light-grayish-brown, thin- to poorly bedded, slightly carbonaceous in basal 1 ft	7	0
28. Sandstone, medium-light-gray, very fine grained, thick-bedded, silty, scattered fossil roots	1	6
29. Shale, light-grayish-red to light-olive-gray, nonbedded, very silty	2	3
30. Sandstone, medium-light-gray, fine-grained, massive to thin-bedded, crossbedded, scattered thin silty interbeds	26	0
31. Shale, medium-gray to medium-dark-gray, basal 1 ft light-olive-gray, thin and evenly bedded, silty	7	0
32. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, scattered shale interbeds	1	0
33. Shale, light-grayish-red to light-olive-gray, poorly bedded	2	1
34. Sandstone, medium-light-gray, very fine grained, fine-grained in upper 1½ ft, thin and irregularly bedded, scattered shale interbeds	5	10
35. Shale, grayish-red, basal 7 in light-olive-gray, poorly bedded, silty	2	6
36. Limestone, medium-gray, brittle, fractured	1	6
37. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty; 2-in-thick reddish-gray lens at base		10
38. Shale, grayish-red, thin-bedded	1	10
39. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	6
40. Shale, medium-dark-gray to light-gray, grayish-red in basal 1 ft	3	0
41. Sandstone, medium-light-gray, fine-grained, thin-bedded	2	0
42. Sandstone, light-gray, very fine to fine-grained, friable, thin-bedded	7	6
43. Shale, light-olive-gray to light-grayish-red, thin-bedded	6	8
44. Sandstone, medium-light-gray, very fine grained, thin-bedded, few ripple beds, crossbedded, silty	5	0
45. Shale, medium-gray, thin and evenly bedded, upper 1 in slightly carbonaceous	2	10
46. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, crossbedded, upper 2 ft very calcareous	7	0
47. Shale, medium-gray to grayish-red	16	4
48. Sandstone, very fine grained, grades to fine-grained upward, thin-bedded, crossbedded, silty at base, scattered silty shale and light-gray sandstone lenses	6	0
49. Shale, medium-gray to grayish-red, lens-shaped bedding	3	4
50. Sandstone, medium-light-gray, very fine grained, thin- bedded, silty, calcareous	1	10

	Thickness	
	Ft	in
51. Shale, medium-gray, upper 2 ft grayish-red, thin and evenly bedded, slightly carbonaceous	5	0
52. Sandstone, medium-light-gray to light-gray, very fine to fine-grained, dark and light mineral grains, thin-bedded, crossbedded	7	6
53. Shale, medium-gray to grayish-red, thin and evenly bedded	8	4
54. Sandstone, fine- to medium-grained, thick-bedded to massive, friable, lens-shaped beds	9	0
55. Shale, grayish-red, thin and evenly bedded	17	6
56. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded	10	0
57. Shale, grayish-red, thin and evenly bedded	2	10
58. Sandstone, medium-light-gray, very fine grained, very silty, convolutions	1	0
59. Shale, grayish-red, thin and evenly bedded	4	0
60. Sandstone, medium-light-gray, very fine grained, thin and evenly bedded, silty	1	6
61. Shale, medium-dark-gray to light-olive-gray, grayish-red in top 2 ft, thin and evenly bedded	15	0
62. Sandstone, medium-light to light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded	6	0
63. Shale, grayish-red, thin and evenly bedded	6	0
64. Sandstone, medium-light-gray, fine-grained, thick-bedded, abundant fossil roots	1	6
65. Shale, grayish-red, thin and evenly bedded	2	0
66. Sandstone, very fine grained, thin-bedded, silty	1	6
67. Shale, grayish-red, thin and evenly bedded	13	0
68. Sandstone, medium-light-gray, fine- to medium-grained, thin-bedded to massive, crossbedded, calcareous concretions up to 2 ft in diameter; dark and light mineral grains, friable; contains 2-ft-thick light-olive-gray siltstone lens, 10 ft above base	75	0
69. Shale, grayish-red, thin and evenly bedded	7	0
70. Sandstone, medium-light-gray, weathered grayish-yellow, fine-grained, thin-bedded, crossbedded, very calcareous, contains scattered shale lenses up to 3 ft thick 18 ft above base	50	0
71. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded to massive, basal 20 ft thin-bedded, friable, calcareous	65	0
72. Shale, light-olive-gray to grayish-red, thin- to poorly bedded; 1-ft-thick sandstone bed 9 ft above base	16	0
73. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded	2	6
74. Shale, grayish-red, thin and evenly bedded	2	0
75. Sandstone, medium-light-gray, very fine grained, thin-bedded, very calcareous	4	0
76. Shale, grayish-red, thin and evenly bedded	2	0
77. Sandstone, medium-light-gray, fine-grained, thin-bedded	9	0
78. Shale, grayish-red, thin and evenly bedded	3	0
79. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, crossbedded	6	0
80. Shale, grayish-red, thin and evenly bedded	6	0
81. Sandstone, medium-light-gray to light-gray, very fine to fine-grained, thin- to thick-bedded	16	0
82. Shale, grayish-red, thin and evenly bedded, silty; 6-in-thick ironstone bed 5 ft above base; 10-in-thick light-gray very fine grained silty sandstone lens 11 ft above base; 1½-ft-thick very fine grained sandstone lens 19 ft above base	26	0
83. Sandstone, light-gray, very fine grained, thin- to thick-bedded, slightly calcareous at top	6	0
84. Shale, grayish-red, thin and evenly bedded	11	0
85. Sandstone, light-gray, very fine grained, very calcareous, few fossil roots	1	8
86. Shale, grayish-red, few medium-dark-gray, thin and evenly bedded, scattered thin siltstone and very fine grained sandstone lenses, a 1-ft light-gray, silty sandstone lens 10 ft above base	17	0
87. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	2	6
88. Shale, grayish-red, thin and evenly bedded, scattered lenses of very fine grained sandstone and siltstone up to 1 ft thick	7	0
89. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, dark and light mineral grains	10	0
90. Shale, grayish-red, thin and evenly bedded	10	0
91. Sandstone, light-gray, fine-grained, thin-bedded, high quartz content, calcareous in top 1 ft	4	0
92. Shale, grayish-red, thin and evenly bedded	7	0
93. Sandstone, light-gray, very fine grained, thin- to thick-bedded, thin-bedded at top, very shaly, contains 1-ft-thick calcareous zone 4 ft above base; 3-ft-thick silty zone 8 ft above base; and medium-dark to dark gray shale lens 3 ft above base	37	0
94. Shale, medium-dark-grayish-red, thin and evenly bedded	1	0

	Thickness Ft	 in
95. Sandstone, very fine grained, thin and irregularly bedded, silty	2	6
96. Shale, grayish-red, grades to medium-gray in upper 1 ft thin and evenly bedded	4	0
97. Sandstone, medium-light-gray to light-gray, very fine grained, silty	1	0
98. Shale, light-olive-gray to grayish-red	2	4
99. Sandstone, light-gray, fine-grained, thin-bedded, calcareous in upper 1 ft	3	0
100. Shale, grayish-red to medium-dark-gray, thin and evenly bedded, contains 1-ft-thick dark-grayish-purple carbonaceous zone 5 ft above base	9	0
101. Sandstone, medium-light-gray, very fine grained, crossbedded, scattered shale interbeds, silty	1	2
102. Shale, dark-grayish-red to olive-green, thin and evenly bedded	3	6
103. Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thin- to thick-bedded, crossbedded	5	0
104. Shale, medium-gray to medium-dark-gray; 2-ft-thick lens of grayish-red to olive-green shale 5 ft above base; becomes very silty and sandy in top 3 ft	24	0
105. Sandstone, medium-light-gray; very fine to fine-grained, thin-bedded, silty, light-brown shale interbeds in basal 1 ft	2	6
106. Ironstone, yellow-brown to dark-red, irregular concretions, very fine banding	1	6
107. Shale, light-olive-brown, thin and evenly bedded	1	0
108. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, dark and light mineral grains	3	0
109. Shale, medium-dark-gray to grayish-red to olive-green, thin and evenly bedded, very silty in upper 3 ft	12	0
110. Sandstone, light-gray, fine- to medium-grained, dark and light mineral grains, thin- to thick-bedded, crossbedded, friable	12	0
111. Shale, light-olive-gray to dark-grayish-brown to grayish-red, 2-ft-thick grayish-green silty zone 9 ft above base	12	0
112. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded		10
113. Shale, grayish-red to light-greenish-gray, upper 6 in very silty	1	2
Unconformity		
Total measured thickness of main body of Mesaverde Formation	826	3
White sandstone member:		
114. Sandstone, light-gray to white; basal 3 ft light greenish gray, coarse grained, conglomeratic; thick-bedded to massive, crossbedded, scattered shale chips, friable, upper 1 ft calcareous with scattered pyrite nodules	200	0
115. Shale, light-gray, nonbedded	3	0
Total measured thickness of white sandstone member of Mesaverde Formation	203	0
Total measured thickness of Mesaverde Formation	1,029	3

Measured section 8: Cody Shale and Mesaverde Formation

Location: Crowheart NE. Quadrangle, Wyoming (7.5 min)
Start: NE–NE–NW sec. 31, T. 6 N., R. 2 W. Presented from oldest to youngest
End: SW–SW–NW sec. 29, T. 6 N., R. 2 W.
Described by: R.C. Warlow and J.F. Windolph, Jr.
Strike 85°, Dip 30° NW.

	Thickness Ft	 In
Upper Cretaceous:		
Code Shale:		
1. Sandstone, medium-light-gray, very fine grained, thin and evenly bedded, calcareous	1	10
2. Shale, medium-gray, silty, few scattered very fine grained sandstone laminations, 3 to 4 in thick; 1-ft-thick very fine grained sandstone lens 16 ft above base; 3-ft-thick very fine grained sandstone lens 31 ft above base; 1-ft-thick very fine grained sandstone lens 56 ft above base; 1½-ft-thick very fine grained sandstone lens 61 ft above base; 1-ft-thick very fine grained sandstone lens 77 ft above base; 10-ft-thick sandy, silty zone 87 ft above base; 1-ft-thick very fine grained calcareous sandstone lens 97 ft above base	127	0
Total measured thickness of Cody Shale	128	10
Mesaverde Formation:		
3. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, silty, variable resistant beds, crossbedded	55	0
4. Siltstone, medium-gray, crossbedded, shaly, scattered thin, very fine grained sandstone laminations, thin-bedded	5	0
5. Sandstone, medium-light-gray, thin- bedded to massive, pyrite nodules, very silty, crossbedded, solution cavities, scattered ripple beds, very calcareous at top, thinly bedded, pyrite nodules	98	0
6. Sandstone, light-gray, fine-grained, crossbedded, thin- to thick-bedded, solution cavities, scattered pyrite nodules, fossil roots at top	15	0
Base of Maverick Spring coal zone		
7. Coal, bright, in thin bands, weathered, basal ½ in sandstone interbeds, resin blebs, fine cleats		6

	Thickness	
	Ft	in
8. Tonstein, medium-yellow-brown, fossil roots, carbonaceous fragments, flattened volcanic ash particles		2
9. Coal, bright, banded, fusain at top		8
10. Shale, medium-gray, basal 1 in light-grayish-brown and carbonaceous		10
11. Siltstone, medium-light-gray, thin-bedded, very fine grained sandstone laminations, shale and carbonaceous laminations	1	6
12. Sandstone, light-gray, very fine grained, thin- to medium-bedded, silty, medium-light-gray in basal 4½ ft, thick-bedded at top; 1-ft-3-in-thick medium-gray shale lens 7½ ft above base	14	6
13. Underclay, medium-gray, poorly bedded, fossil roots, upper 5 in light-brownish-gray, silty, carbonaceous, sulfur-stained; tonstein bed in upper 2 in	2	9
14. Coal, bright, banded, resin blebs	1	2
15. Tonstein, light-grayish-brown, fossil plant fragments		2
16. Coal, gypsum crystals, resin blebs, weathered, bright, few impure thin partings, few thin shale laminations in lower 1 in	1	4
17. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	6
18. Shale, medium-gray, thin-bedded, silty, scattered siltstone and sandstone laminations, top grades into unit 19	1	11
19. Siltstone, medium-light-gray, thin-bedded, sandy	1	1
20. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, slightly calcareous	6	6
21. Shale, medium-gray, thin and evenly bedded, slightly carbonaceous, lens-shaped	1	10
22. Sandstone, light-gray, fine-grained, thick-bedded, lens-shaped, pyrite nodules, fossil roots in top part	2	0
23. Underclay, medium-grayish-brown, carbonaceous, fossil roots, silty.		11
24. Coal, resin blebs, bright, banded, fine cleats		6
25. Underclay, medium-gray to medium-dark-gray, fossil roots, coal fragments, poorly bedded, upper 2 in hard and silty	1	9
26. Coal, gypsum, bright, thin bands, fine to medium cleats, iron-stained	1	1
27. Tonstein, light-brown-gray, granular, resin blebs, coal fragments, fossil plant impressions		4
28. Coal, bright, basal 1 in contains fusain and shaly laminations, thin-banded, very slightly impure, fine to medium cleats	1	7
29. Shale, light-grayish-brown, carbonaceous, silty, flattened tree trunks, coal lenses, resin blebs, thin-bedded, few fossil roots		9
30. Coal, bright, banded, resin blebs, gypsum crystals, fine to medium cleats	1	4
31. Tonstein, light-brownish-gray, coal interbeds; sulfur-stained, flattened, volcanic ash fragments, coal fragments, and tree trunks, resin blebs, gypsum crystals; top gradational		5
32. Shale, medium-gray, basal 2 in carbonaceous, top gradational	2	0
33. Sandstone, medium-gray, very fine grained, thin-bedded, silty	2	6
34. Underclay, medium-gray, slightly silty, fossil plants, ½-in coaly lens at top	1	0
35. Shale, medium-gray, thin- to poorly bedded	4	0
36. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	4
37. Shale, medium-gray, 6-in pyrite nodule band 11 in above base, very bentonitic, fossil roots at top	3	0
38. Tonstein, medium-brown-gray, coal fragments		4
39. Coal, impure, banded, resin blebs, fine cleats		6
40. Shale, medium-gray, poorly bedded	3	6
41. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded		11
42. Underclay, medium-gray, bentonitic, fossil roots	1	6
43. Coal, impure, shaly		4
44. Shale, medium-gray to medium-dark-gray; 4-in-thick bentonitic shale at base	6	0
45. Siltstone, medium-light-gray, very fine grained sandstone laminations	3	0
46. Sandstone, medium-light-gray, very fine grained, calcareous, silty		5
47. Shale, medium-gray		6
48. Underclay, medium-gray, fossil roots	2	0
49. Coal, bloom, weathered		2
50. Underclay, medium-gray, bentonitic, tonstein fragments in top 1 in, fossil roots, coal fragments	2	6
51. Coal, bloom, weathered		2
52. Shale, medium-gray		6
53. Siltstone, medium-gray, very fine grained sandstone laminations, shaly, fossil leaf impressions	4	0
54. Shale, medium-gray, scattered siltstone laminations	4	0
55. Sandstone, medium-light-gray, very fine grained, very calcareous, thin- to thick-bedded, pyrite nodules	5	0
56. Siltstone, very calcareous, lens-shaped bedding	6	0
57. Shale, medium-gray, thin and evenly bedded, bentonitic in top 1 ft	2	6
58. Sandstone, medium-light-gray, fine-grained, some medium-grained, thin- to thick-bedded, very calcareous, iron-stained, pyrite nodules, lens-shaped bedding	2	0
59. Sandstone, medium-light-gray, fine-grained, some medium-grained, dark		

	Thickness	
	Ft	in
and light mineral grains, thin-bedded to massive, fractures filled with quartz, crossbedded, solution cavities; pyrite nodules; calcareous at top; calcareous 20 ft above base	53	0
60. Shale, medium-gray; 4-in-thick limy siltstone 5 in above base	2	6
61. Sandstone, light-gray, very fine grained, thin and unevenly bedded, dark and light mineral grains	2	0
62. Underclay, medium-gray, bentonitic		7
63. Tonstein, medium-brownish-gray, flattened volcanic ash granules		2
64. Coal, bloom, weathered		6
65. Shale, medium-gray, poorly bedded	10	0
66. Sandstone, medium-light-gray, fine grained to medium-grained, calcareous, lens-shaped bedding	4	0
67. Underclay, medium-dark-gray, fossil roots, carbonaceous		10
68. Coal, dull, slightly bony, banded at top, medium cleats, yellow resin blebs at base	1	4
69. Shale, medium-gray, silty		6
70. Sandstone, medium-light-gray, very fine grained, silty, thin and unevenly bedded, fossil plant fragments	2	0
71. Shale, medium-gray, poorly bedded, silty, few fossil roots		9
72. Shale, dark-gray, slightly carbonaceous		2
73. Coal, impure, top eroded, shaly		2
Top of Maverick Spring coal zone		
74. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thin- to thick-bedded	2	0
75. Shale, nonbedded, silty, slightly bentonitic	3	0
76. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, thin- to thick-bedded, scattered pyrite nodules, silty, calcareous toward top	39	0
77. Siltstone, medium-light-gray, thin- to poorly bedded, sandy, 7-in sandstone lens at top	4	3
78. Shale, medium-dark-gray, silty, slightly carbonaceous	3	0
79. Concealed, probably carbonaceous silty shale	9	0
80. Siltstone, medium-light-gray, very fine grained sandstone; scattered shaly laminations	4	0
81. Shale, medium-gray, slightly carbonaceous in top 3 in with coal fragments	2	0
82. Sandstone, medium-light-gray, very fine grained		7
83. Bone, sandy, detrital, resin blebs		3
84. Shale, medium-gray, coal fragments, silty	15	0
85. Siltstone, medium-light-gray, scattered shale and siltstone laminations	2	0
86. Sandstone, medium-light-gray, very fine grained, solution cavities, silty, slumped beds	1	0
87. Siltstone, medium-light-gray, thin- to poorly bedded, shaly	2	6
88. Underclay, medium-gray, fossil roots, silty	2	2
89. Coal, shaly, impure		1
90. Shale, medium-gray, thin- to poorly bedded, fossil plants, upper 8 in very carbonaceous	1	7
91. Sandstone, medium-light-gray, fine-grained, thick-bedded, thin-bedded and silty at top; calcareous at base	4	0
92. Underclay, medium-gray, silty, fossil roots	2	6
93. Coal, bright, impure		3
94. Underclay, medium-gray, poorly bedded, fossil roots, 1-in coaly carbonaceous shale at top	3	6
95. Shale, medium-gray, thin and evenly bedded, becomes silty at top	1	2
96. Sandstone, medium-light-gray, very fine to fine-grained, silty, scattered pyrite nodules, crossbedded	2	0
97. Shale, medium-gray, nonbedded, 8-in-thick pyrite nodule band 8 in below top, slightly bentonitic, gypsum crystals	12	0
98. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, silty	5	0
99. Shale, medium-gray, thin and evenly bedded, 4-in-thick pyrite nodule band 5 ft above base	12	0
100. Sandstone, light-gray, very fine grained, thin-bedded, silty, solution cavities		11
101. Underclay, medium-gray, nonbedded, upper 7 in slightly carbonaceous	2	0
102. Coal, bony, impure, resin blebs, banded		3
103. Shale, medium-gray, silty, pyrite nodules	1	6
104. Siltstone, medium-gray, thin-bedded, sandy	3	6
105. Shale, medium-gray, thin and evenly bedded, iron-stained	2	6
106. Sandstone, medium-light-gray, dark and light mineral grains, crossbedded, solution cavities, pyrite nodules, basal 2½ ft very silty and friable	8	0
107. Underclay, medium-dark-gray, fossil roots, bentonitic in lower half, carbonaceous in upper half	5	0
108. Shale, dark-brownish-gray, thin-bedded, carbonaceous, silty, abundant fossil plant fragments, few coal laminations at top		7
109. Coal, bright, thin bands, resin blebs	2	1
110. Shale, medium-gray, silty, carbonaceous laminations	1	10
111. Sandstone, very fine grained, thin-bedded, crossbedded, silty	4	2
112. Siltstone, medium-gray, thin-bedded, sandy, shaly	1	8
113. Shale, light-grayish-brown, thin-bedded, carbonaceous, coal fragments, bony		3
114. Coal, upper 1 in impure, bright, banded, abundant resin blebs		5

	Thickness	
	Ft	in
115. Shale, medium-gray, poorly bedded, top gradational		6
116. Siltstone, medium-gray, crossbedded, thin and irregularly bedded, sandy	1	8
117. Sandstone, medium-light-gray, very fine to fine-grained, few medium grains, dark and light mineral grains, thin- to thick-bedded, crossbedded, friable, pyrite nodules	3	0
118. Underclay, medium-gray, shaly, slightly bentonitic	5	0
119. Shale, light-brown-gray, carbonaceous		2
120. Coal, bloom, resin blebs, weathered		3
121. Siltstone, medium-gray, thin and irregularly bedded, slightly calcareous	6	6
122. Sandstone, very fine grained, thin- to thick-bedded, silty, calcareous	3	6
123. Shale, medium-gray, poorly bedded	2	10
124. Siltstone, medium-light-gray, very calcareous		10
125. Underclay, medium-gray, nonbedded, bentonitic	2	6
126. Shale, carbonaceous, thin-bedded, weathered, few coal fragments		4
127. Shale, medium-gray, thin and evenly bedded, top grades into unit 128	1	4
128. Sandstone, very fine grained, thin and evenly bedded, silty, calcareous	1	6
129. Underclay, medium-gray, nonbedded, bentonitic	7	0
130. Shale, dark-gray to black, coaly, thin and irregularly bedded, resin blebs, silty, bony lens	1	8
131. Shale, medium-gray, thin and evenly bedded, nonbedded in upper 1 ft, top grades into unit 132	4	0
132. Coal, bloom, weathered		4
133. Shale, medium-gray, thin and evenly bedded, poorly bedded toward top, silty at top	5	0
134. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, thin to thick and irregularly bedded, pyrite nodules	5	0
135. Sandstone, medium-light-gray, fine-grained, some medium-grained, massive, friable, pyrite nodules, silty, lens-shaped beds, crossbedded, calcareous concretions up to 1 ft in diameter; few siltstone and shale laminations in upper part; thin-bedded and calcareous at top; resistant in upper 10 ft	30	0
136. Bentonite, light-yellowish-brown, upper 4 in carbonaceous shale	7	0
137. Coal, bloom, bright, shaly, impure, resin blebs		3
138. Bentonite, light-yellowish-brown, few pyrite nodules, upper 2 ft thin-bedded, medium-gray shale	8	6
139. Sandstone, medium-light-gray, very fine to fine-grained, slightly silty, basal 1 ft resistant, thin- to thick-bedded, crossbedded, pyrite nodules	1	6
140. Shale, medium-gray, thin-bedded, silty, thin sandstone laminations at base; lens-shaped bedding	2	0
141. Sandstone, medium-light to light-gray, fine-grained, dark and light mineral grains, crossbedded, thin- to thick-bedded, pyrite nodules	2	0
142. Shale, medium-gray, poorly bedded, pyrite nodules, scattered siltstone and sandstone laminations	13	0
143. Sandstone, medium-light-gray, very fine to fine-grained, crossbedded, shale chips at base, slightly calcareous	18	0
144. Shale, medium-gray, slightly silty, scattered siltstone laminations; carbonaceous zone 10 ft above base; upper 3 ft silty and thin bedded	18	0
145. Sandstone, light-medium-gray, very fine to fine-grained, crossbedded, thin- to thick-bedded, slumped bedding	3	0
146. Shale, medium-gray, nonbedded, few carbonaceous laminations	5	0
147. Sandstone, light-gray, very fine grained, thick-bedded, silty	3	0
148. Shale, light-brownish-gray, fossil plant fragments, few fossil roots	1	6
149. Sandstone, medium-light-gray, very fine grained, thin-bedded, calcareous, silty	2	6
150. Shale, medium-gray, thin-bedded	2	0
151. Sandstone, medium-light-gray to light-gray, dark and light mineral grains, fossil roots and fragments, silty, pyrite nodules	1	4
152. Siltstone, medium-gray to medium-dark-gray, thin-bedded, pyrite nodule bands; slightly carbonaceous	2	0
153. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, top grades into unit 154	1	10
154. Shale, medium-light-gray, thin-bedded, scattered siltstone laminations	5	0
155. Sandstone, medium-light-gray, very fine grained, calcareous, thick-bedded, silty, burrowed		10
156. Shale, medium-gray to medium-dark-gray, thin and evenly bedded		9
157. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	4
158. Shale, medium-gray, thin to poorly bedded	5	6
159. Sandstone, medium-light-gray, fine-grained, crossbedded, thick-bedded, silty, siltstone laminations	3	4
160. Shale, medium-light-gray to medium-gray, poorly bedded, top gradational	8	0
161. Sandstone, very fine to fine-grained, massive, silty, pyrite nodules, solution cavities, calcareous concretions up to 2 ft in diameter	52	0
162. Shale, medium-gray, thin-bedded, slightly carbonaceous, basal 5 in silty	1	6
163. Sandstone, light-gray, very fine grained, crossbedded, thin-bedded, pyrite nodules	1	6

		Thickness	
		Ft	in
164.	Shale, light-brownish-gray, carbonaceous, silty	1	2
165.	Coal, impure, resin blebs, shaly, weathered		3
166.	Shale, medium-gray, thin-bedded to poorly bedded	5	6
167.	Sandstone, fine-grained and locally medium-grained, thick-bedded to massive, crossbedded, scattered pyrite nodules, solution cavities, ripple-bedded at top and calcareous	25	0
168.	Siltstone, medium-light-gray, scattered shale laminations	4	6
169.	Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, silty	2	0
170.	Shale, medium-gray, thin-bedded, few siltstone laminations, slightly carbonaceous	6	0
171.	Sandstone, medium-light-gray, very fine grained, crossbedded, thin and irregularly bedded, silty, very calcareous	2	2
172.	Shale, medium-gray to medium-dark-gray, thin-bedded; 2-in-thick siltstone laminations 1 ft above base	5	2
173.	Underclay, medium-brownish-gray, sandy, fossil roots	1	6
174.	Coal, bloom, weathered		4
175.	Sandstone, medium-light-gray, fine-grained, some medium-grained, dark and light mineral grains, thick-bedded to massive, calcareous, solution cavities, scattered pyrite nodules	61	0
176.	Shale, medium-gray, nonbedded	5	0
177.	Sandstone, light-gray to medium-light-gray, very fine to fine-grained, crossbedded, massive, scattered pyrite nodules, thin-bedded and calcareous in top 3 ft, solution cavities	33	0
178.	Siltstone, medium-gray, thin-bedded	4	6
179.	Shale, medium-gray, thin-bedded, slightly carbonaceous	6	6
180.	Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, nonresistant	2	2
181.	Shale, medium-gray, slightly silty, scattered carbonaceous laminations	3	6
182.	Siltstone, medium-light-gray, very fine grained, thin and irregularly bedded, sandy	3	6
183.	Shale, medium-gray, thin-bedded to poorly bedded, becomes silty at top	3	0
184.	Sandstone, very fine grained, silty, crossbedded, thick-bedded to massive, scattered pyrite nodules, very calcareous in top 1 ft	13	0
185.	Shale, medium-gray, silty, scattered pyrite nodule laminations	2	0
186.	Shale, light-grayish-brown, carbonaceous, few coal fragments, silty	1	8
187.	Shale, medium-gray, thin-bedded, upper 6 in slightly carbonaceous	2	2
188.	Sandstone, medium-light-gray, very fine grained, silty, thick-bedded	1	4
189.	Underclay, medium-gray, fossil roots	3	6
190.	Shale, light-grayish-brown, carbonaceous		4
191.	Shale, medium-gray, thin and evenly bedded		4
192.	Sandstone, medium-light-gray, very fine grained, thin- to thick- bedded, crossbedded, silty	2	8
193.	Shale, medium-gray, thin and poorly bedded, upper 4 ft bentonitic	8	0
194.	Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, massive, very calcareous	6	6
195.	Shale, medium-gray to medium-dark-gray, slightly carbonaceous 6½ ft above base, top thin- and evenly bedded	9	0
196.	Siltstone, medium-light-gray, thin and evenly bedded	1	4
197.	Shale, medium-gray, thin and evenly bedded	1	0
198.	Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, crossbedded, very calcareous, scattered pyrite nodules	3	0
199.	Shale, medium-gray, thin and evenly bedded	3	0
200.	Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, calcareous	2	6
201.	Shale, medium-gray to light-olive-gray, poorly bedded	4	0
202.	Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, slightly calcareous, silty	1	10
203.	Shale, medium-gray to light-olive-gray, poorly bedded	3	10
204.	Sandstone, medium-light-gray, very fine grained, very silty, dark and light mineral grains, thin-bedded to massive, scattered pyrite nodules, lens-shaped bedding	6	6
205.	Underclay, medium-gray, poorly bedded, fossil roots	1	6
206.	Coal, impure, shaly		1
207.	Shale, medium-gray to medium-dark-gray, thin-bedded, slightly carbonaceous in upper 1 ft, slightly silty	8	0
208.	Sandstone, medium-light-gray, very fine grained, very silty, thin and irregularly bedded, massive in lower 8 in, very calcareous, scattered plant fossils in basal 1 ft, 4-in medium-gray shale lens 2 ft above base	4	6
209.	Shale, medium-gray, thin and evenly bedded		7
210.	Sandstone, medium-light-gray, very fine grained, very silty, scattered pyrite nodules, solution cavities, calcareous	2	3
211.	Shale, medium-gray, poorly bedded	1	0
212.	Sandstone, medium-light-gray, very fine grained, silty, thick-bedded, very calcareous		10

	Thickness	
	Ft	in
213. Shale, medium-gray to light-grayish-brown, slightly carbonaceous, thin and evenly bedded	1	4
214. Sandstone, medium-light-gray, very fine grained, silty		9
215. Shale, medium-gray to light-grayish-brown, thin and evenly bedded, slightly carbonaceous	1	10
216. Sandstone, medium-light-gray, very fine grained, very silty, thin and irregularly bedded	1	0
217. Shale, medium-gray, poorly bedded	2	10
218. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, slightly calcareous, thick-bedded	1	2
219. Shale, medium-gray to light-olive-gray, basal, 3 ft 3 in poorly bedded, upper portion thin and evenly bedded	6	6
220. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded		11
221. Shale, medium-gray, thin and poorly bedded	2	8
222. Sandstone, medium-light-gray, very fine grained, very silty, thin-bedded to massive, crossbedded, very calcareous, scattered pyrite nodules	6	10
223. Underclay, medium-gray, poorly bedded		8
224. Shale, light-grayish-brown, carbonaceous, silty, abundant fossil plant fragments, few fossil roots	1	0
225. Coal, bright attritus, banded, medium cleats, rosin, fusain, slightly carbonaceous, fossil plant fragments		7
226. Shale, medium-gray, thin and evenly bedded, slightly carbonaceous, fossil plant fragments		4
227. Sandstone, medium-light-gray, very fine grained, silty, calcareous, thin- to thick-bedded, lens-shaped	1	6
228. Shale, medium-gray to light-olive-gray, thin and poorly bedded, upper 1 ft grades silty, few fossil plants	9	6
229. Sandstone, medium-light-gray, very fine grained, slightly silty, very calcareous, thin- to thick-bedded, crossbedded, scattered pyrite nodules	5	6
230. Shale, medium-gray, thin and evenly bedded, few fossil plant fragments, upper 1 ft contains few fossil roots, nonbedded with coal fragments	6	8
231. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, thin and irregularly bedded, silty, very slightly calcareous	4	0
232. Shale, medium-gray, thin-bedded, contains 8-in-thick very fine grained sandstone 2 ft above basal contact	5	0
233. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thin-bedded to massive, very calcareous, lens-shaped bedding, scattered pyrite nodules, top 1 ft very silty	13	0
234. Shale, medium-gray to medium-dark-gray, thin and evenly bedded; contains 1-ft-thick thin-bedded, very fine grained sandstone 6 ft above basal contact	10	0
235. Siltstone, medium-light-gray, thin and irregularly bedded, medium-gray shale laminations 10 percent; 4-in-thick shale zone at top	3	0
236. Sandstone, medium-light-gray, very fine grained, very slightly calcareous, massive, crossbedded, few scattered pyrite nodules	1	2
237. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	1	6
238. Sandstone, medium-light-gray, very fine grained, very silty, crossbedded, very slightly calcareous, scattered pyrite nodules	3	0
239. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, basal 1 ft slightly carbonaceous, becomes silty at top	12	6
240. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, thick-bedded to massive, crossbedded, scattered pyrite nodules, calcareous, slightly silty, basal 1 ft thin-bedded and silty; 1-ft-thick shale lens 1 ft below top	31	0
241. Underclay, medium-gray to light-olive-gray, nonbedded	5	0
242. Shale, light-gray-brown, silty, thin and irregularly bedded, abundant fossil plant fragments and roots	2	8
243. Coal, bright, impure, bony, resin bleb		5
244. Shale, light-gray-brown, carbonaceous		6
245. Shale, medium-gray to medium-dark-gray, thin and evenly bedded; basal 8 in medium dark gray, very carbonaceous	3	0
246. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, slightly silty, calcareous, thin- to thick-bedded, scattered pyrite nodules	8	0
247. Shale, medium-gray, thin- to poorly bedded, 8-in-thick very fine grained sandstone 1 ft above base; upper 3 ft very fine bedded, slightly silty, ½ in of shaly coal at top	8	0
248. Sandstone, medium-light-gray, fine-grained with few medium grains, abundant dark and light mineral grains, thick-bedded to massive, pyrite nodules, solution cavities, top 2 ft thin-bedded, iron-stained, resistant at center	18	6
Section offset 2,000 ft east		
249. Underclay, medium-gray to light-olive-gray, fossil roots		8
250. Shale, light-grayish-brown, thin and evenly bedded, silty, coal fragments, fossil plant fragments		2

	Thickness	
	Ft	in
251. Shale, medium-gray, silty, very fine grained sandstone, top gradational into unit 252		4
252. Sandstone, very fine-grained, dark and light mineral grains, thick-bedded, slightly silty, noncalcareous, sparsely micaceous, scattered resin blebs, scattered pyrite nodules, fossil leaf impressions	1	6
253. Shale, medium-dark-gray to mostly medium-gray, thin and poorly bedded, few grayish-red laminations in central part of unit are light-olive-gray and mostly poorly bedded	14	6
254. Sandstone, medium-light-gray, silty, very fine grained, thick-bedded to massive, thin-bedded toward top, locally crossbedded, scattered pyrite nodules, few resistant ledges, calcareous, very silty in top 3 ft	28	0
255. Shale, medium-gray to medium-dark-gray, thin-bedded	2	6
256. Sandstone, light-gray, very fine grained, dark and light mineral grains, micaceous, crossbedded, base sharp and angular, noncalcareous, scattered pyrite nodules	3	0
257. Shale, medium-gray to light-olive-gray, poorly bedded	4	6
258. Shale, light-brown-gray, very carbonaceous, few fossil plant fragments and roots, coal fragments, slightly bony to bright coal at top with resin blebs	1	4
259. Shale, medium-gray, thin and evenly bedded, upper 4 in light-grayish-brown, carbonaceous	5	0
260. Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty, slightly calcareous	1	9
261. Underclay, medium-gray, nonbedded, few siltstone interbeds, fossil rootlets	2	4
262. Shale, light-grayish-brown, thin-bedded, abundant coal laminations, very carbonaceous		3
263. Coal, weathered, bright, resin blebs, banded		2
264. Shale, medium-gray, thin and evenly bedded, basal 3 in very carbonaceous	7	9
265. Sandstone, light-gray, very fine grained, dark and light mineral grains, calcareous, crossbedded, thin- to thick-bedded, iron-stained	1	2
266. Shale, medium-gray, slightly carbonaceous, thin and evenly bedded, 1-ft-thick silty zone 1 ft 3 in above base, few fossil rootlets in silty zone	7	6
267. Sandstone, light-gray, very fine grained, dark and light mineral grains, thin- to thick-bedded, scattered pyrite nodules, very calcareous, fossil roots in top 3 in	2	0
268. Underclay, medium-gray, fossil rootlets, upper 1 ft very carbonaceous and thin-bedded	2	2
269. Sandstone, light-gray, very fine grained, silty, thin- to thick-bedded, scattered pyrite nodules, very calcareous	1	4
270. Shale, medium-gray, thin and evenly bedded, few carbonaceous plant fragments	3	0
271. Sandstone, very light gray to white, very fine to fine-grained, scattered dark mineral grains, very calcareous, thin- to thick-bedded, scattered worm burrows, scattered pyrite nodules, iron laminations, calcareous iron-stained concretions 1 ft 2 inches in diameter 9 in above base	22	0
272. Shale, medium-gray, poorly bedded, few fossil roots, pyrite nodules	2	8
273. Sandstone, medium-light-gray, very fine grained, very silty, thin and irregularly bedded, noncalcareous	4	6
274. Shale, medium-gray to medium-dark-gray, scattered carbonaceous material in basal 2 ft, pyrite nodules with plant prints	3	0
275. Underclay, medium-gray to light-olive-gray, nonbedded, fossil rootlets, locally silty	9	6
276. Shale, light-grayish-brown, coal fragments		2
277. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	6	0
278. Shale, medium-gray, poorly bedded, few coaly fragments at top	6	0
279. Sandstone, very fine grained, highly weathered	23	0
Total measured thickness of Mesaverde Formation	1,363	5

Unconformity—Upper part of Mesaverde Formation, and Meeteetse, Lance, and Fort Union Formations not present.

Indian Meadows Formation:

Overlying unit contains coarse conglomerate	Unit not measured

End of section

Measured section 8a: Mesaverde Formation

Location: Crowheart NE. Quadrangle, Wyoming (7.5 min)
Start: SE–SE–NW sec. 29, T. 6 N., R. 2 W. Presented from oldest to youngest
End: NE–SE–NW sec. 29, T. 6 N., R. 2 W.
Described by: R.C. Warlow and J.F. Windolph, Jr.
Strike 90°, Dip 30° N.

	Thickness	
Upper Cretaceous:		
Mesaverde Formation:	Ft	in
1. Shale, medium-gray, poorly bedded, top 7 in sandy and silty	3+	
2. Sandstone, light-gray, very fine grained, silty, calcareous, thin and irregularly bedded		8

		Thickness	
		Ft	in
3.	Shale, medium-gray, thin and evenly bedded, silty	2	6
4.	Sandstone, light-gray, very fine grained, very silty	1	0
5.	Sandstone, light-gray, very fine grained, calcareous, thin- to thick-bedded, dark and light mineral grains		2
6.	Siltstone, medium-gray, thin and evenly bedded, sandy	1	0
7.	Shale, medium-gray, thin and evenly bedded, few fossil plants	2	1
8.	Siltstone, medium-gray, thin-bedded, sandy	1	0
9.	Shale, medium-gray, thin and irregularly bedded, scattered thin siltstone and sandstone laminations	6	0
10.	Sandstone, light-gray, very fine grained, thin-bedded, very calcareous, dark and light mineral grains, scattered pyrite nodules, base sharp	1	6
11.	Shale, medium-gray, thin-bedded	2	6
12.	Siltstone, medium-light-gray, sandy, thin and irregularly bedded, grades sandy upward, few carbonaceous fragments at base	3	0
13.	Sandstone, light-gray, fine-grained, thin and irregularly bedded, abundant dark and light mineral grains, very calcareous, silty in basal 1 ft	3	6
14.	Shale, medium-gray, thin- to poorly bedded	2	6
15.	Sandstone, fine-grained, very silty		4
16.	Shale, medium-gray, silty, bentonitic in top 2 ft, scattered sand lenses	5	0
17.	Sandstone, light-gray, very fine to fine-grained, abundant dark mineral grains, irregularly bedded, slightly calcareous	4	6
18.	Shale, medium-gray, nonbedded, very silty and sandy in upper half	4	0
19.	Sandstone, medium-gray, very fine grained, very silty, slightly calcareous, slightly bentonitic	1	0
20.	Shale, medium-gray, poorly bedded, slightly bentonitic 2 ft 3 in below top	4	6
21.	Sandstone, light-gray, very fine grained, thin and irregularly bedded, slightly silty, scattered carbonaceous material	5	0
22.	Shale, medium-gray, thin and evenly bedded, slightly carbonaceous	3	0
23.	Sandstone, light-gray, very fine to fine-grained, few medium grains, abundant dark and light mineral grains, very slightly calcareous, thin- to thick-bedded, thin-bedded and silty in top 2 ft	13	6
24.	Shale, medium-gray, medium-dark-gray in basal l ft; very fine grained, thin and evenly bedded, silty, sandstone laminations in upper half of unit	4	0
25.	Sandstone, medium-light-gray, very fine grained, very silty	1	0
26.	Shale, medium-gray, poorly bedded, scattered fossil plants	1	0
27.	Sandstone, medium-light-gray, very fine grained, thin-bedded, very silty		6
28.	Shale, medium-gray, irregularly bedded	1	6
29.	Sandstone, light-gray, very fine grained, thin- to thick-bedded, very silty	2	0
30.	Shale, medium-gray, thin-bedded to nonbedded, grades to medium-dark-gray toward top	3	8
31.	Siltstone, light-gray, thin-bedded, very iron stained	2	0
32.	Shale, medium-gray, thin-bedded	4	6
33.	Sandstone, medium-gray, fine-grained, few medium grains, thin- to thick-bedded, abundant dark mineral grains, abundant pyrite nodules	1	6
34.	Sandstone, light-gray to white, fine-grained, crossbedded, thin-bedded to massive, scattered shale chips and pyrite nodules, solution cavities, abundant dark and light mineral grains, few thin shale lenses toward top; 1-ft-thick shale lens 32 ft above base, fossil roots in top 1 ft	35	0
35.	Underclay, medium-gray to medium-dark-gray, fossil rootlets	1	6
36.	Shale, light-grayish-brown, very carbonaceous, few fossil rootlets, abundant fossil plant material	1	0
37.	Coal, weathered, impure, scattered shale lenses		10
38.	Sandstone, light-gray to white, fine- to medium-grained, abundant dark mineral grains, crossbedded, scattered pyrite nodules	7	0
39.	Shale, medium-gray, abundant sand grains, silty, lens-shapped bedding	3	0
	Total measured thickness of main body of Mesaverde Formation	141	3

Unconformity

White sandstone member:

		Thickness	
		Ft	in
40.	Sandstone, light-gray to white, fine- to medium-grained, mostly medium-grained in upper half of unit; shale chips and mineral grains in basal 1 ft; conglomeratic lens 3 ft above base, with quartz pebbles up to ½ inch in diameter	11	0
41.	Sandstone, light-gray to white, fine- to medium-grained, few coarse grains in basal 2 ft; thick-bedded to massive, crossbedded, scattered pyrite nodules	45	0
42.	Shale, medium-dark-gray to medium-gray, weathered, poorly bedded, carbonaceous, fossil rootlets	5	0
43.	Sandstone, light-gray to white, weathered, very friable, fine-grained, silty	12	0
44.	Shale, medium- to medium-dark-gray, unevenly bedded	3	0
45.	Sandstone, light-gray to white, fine-grained, abundant dark mineral grains, thin- to thick-bedded, crossbedded, scattered pyrite nodules	4	6

		Thickness	
		Ft	in
46.	Shale, medium-gray, thin-bedded	2	0
47.	Sandstone, light-gray to white, fine- to medium-grained, thick-bedded to massive, abundant dark mineral grains, scattered carbonaceous fragments, iron-stained, scattered pyrite nodules	2	4
48.	Shale, medium-gray, thin-bedded, slightly bentonitic, fossil rootlets	1	10
49.	Sandstone, light-gray, fine- to medium-grained, thick-bedded to massive, very calcareous, abundant dark mineral grains, scattered pyrite nodules	1	6
50.	Shale, medium-gray to medium-dark-gray, slightly bentonitic, scattered slightly carbonaceous shale lenses	5	6
51.	Sandstone, light-gray to white, fine-grained, thin- to thick-bedded, abundant dark mineral grains, noncalcareous	12	0
52.	Shale, medium-dark-gray, slightly carbonaceous, poorly bedded to nonbedded	4	0
53.	Sandstone, light-gray to white, very fine grained, thin- to thick-bedded, scattered dark mineral grains	15+	—
	Total measured thickness of white sandstone member of Mesaverde Formation	123	10
	Total measured thickness of Mesaverde Formation	265	1
Unconformity			
Indian Meadows Formation:			
	Overlying unit contains coarse conglomerate with abundant petrified wood fragments	Unit not measured	

Measured section 8b: Mesaverde Formation

Location: Crowheart NE. Quadrangle, Wyoming (7.5 min)
Start: SE–NE–SW sec. 30, T. 6 N., R. 2 W. Presented from oldest to youngest
End: SE–NE–SW sec. 30, T. 6 N., R. 2 W.
Described by: R.C. Warlow and J.F. Windolph, Jr.
Strike 80°, Dip 26° NE.

		Thickness	
Upper Cretaceous:		Ft	in
Mesaverde Formation:			
1.	Shale, medium-dark-gray, thin and evenly bedded, slightly silty at top	1	6+
2.	Sandstone, medium-light-gray to light-gray, very fine to fine-grained, dark and light mineral grains, thin-bedded, fossil roots	1	2
3.	Shale, light-brownish-gray, thin and evenly bedded, coal fragments, resin blebs, fossil plants, basal 1 in medium-gray		4
4.	Coal, abundant resin blebs, bright to dull attritus, slightly impure, banded, fine cleats		8
5.	Tonstein, light-grayish-brown, flattened volcanic ash particles, fossil plant fragments, resin blebs, sulfur-stained		1
6.	Coal, resin blebs, bright to dull, banded	1	6
7.	Tonstein, light-grayish-brown, coal laminations up to 1/2 in thick; flattened volcanic ash particles, sulfur stained, coal fragments		5
8.	Coal, bright to dull attritus, fine cleats, gypsum crystals, sulfur-stained, iron-stained, resin blebs	1	0
9.	Shale, light-grayish-brown, carbonaceous, silty, sandy		2
10.	Sandstone, medium-light-gray to light-gray, very fine to fine-grained, thin and irregularly bedded, basal 6 in silty	1	0
11.	Shale, medium-gray, thin and evenly bedded; 7-in-thick sandstone lens 4 in above base; few thin siltstone laminations	2	2
12.	Siltstone, medium-light-gray, thin and irregularly bedded, very sandy	1	6
13.	Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, solution cavities, scattered pyrite nodules, calcareous at top, silty, crossbedded	4	6
14.	Shale, medium-gray, silty, thin and evenly bedded, pyrite nodules, grades to silty shale in upper 8 in	2	6
15.	Sandstone, medium-light-gray, very fine grained, thin-bedded, calcareous, pyrite nodules	1	2
16.	Siltstone, medium-gray, sandy, thin- to poorly bedded, fossil plants	1	0
17.	Underclay, medium-light-gray, upper 6 in light-grayish-brown, silty, thin- to poorly bedded, fossil plant fragments		7
18.	Coal, thinly banded, upper 1 in bony		7
19.	Shale, medium-gray to light-grayish-brown, thin-bedded, carbonaceous in basal 3 1/2 in, top gradational		7
20.	Siltstone, medium-light-gray, shaly	1	0
21.	Underclay, medium-gray, fossil roots	1	0
22.	Shale, light-grayish-brown, carbonaceous, silty, poorly bedded	1	3
23.	Underclay, medium-gray, fossil roots	1	2
24.	Shale, carbonaceous, thin-bedded		3
25.	Coal, impure, resin blebs		2
26.	Shale, light-grayish-brown to medium-gray, thin and evenly bedded, fossil plant prints and roots		7
27.	Coal, fine to medium cleats, bright, basal 4 in blocky with abundant resin blebs; upper 1/2 in shale laminations		10
28.	Tonstein, light-grayish-brown, fossil plants, flattened volcanic ash fragments		3
29.	Coal, abundant resin blebs, fine to medium cleats, bright, upper 2 in slightly bony	1	8
30.	Shale, light-grayish-brown, thin- to poorly bedded, carbonaceous, fossil plant and root fragments		5
31.	Underclay, medium-gray, nonbedded, abundant fossil roots	1	5

	Thickness	
	Ft	in
32. Coal, fine cleats, bright, banded, resin blebs, upper 3 in impure bony, shale laminations, sulfur-stained, fusain at top	1	1
33. Tonstein, medium-gray-brown, sulfur-stained, flattened volcanic ash particles, coal fragments		3
34. Coal, bright, banded, resin blebs, medium cleats		6
35. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, top gradational	3	0
36. Shale, medium-gray, silty, scattered pyrite nodule bands; 7-in-thick medium-dark-gray bentonitic zone 3½ ft above base; top gradational	5	7
37. Siltstone, medium-light-gray, sandy	1	2
38. Shale, medium-gray to medium-dark-gray, pyrite nodule band at top; thin and evenly bedded; silty in top 4 in	1	10
39. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, crossbedded, calcareous at top	1	9
40. Underclay, medium-gray, basal 4 in silty, slightly bentonitic	2	6
41. Shale, medium-dark-gray to light-grayish-brown, carbonaceous, coal fragments, gypsum crystals	1	0
42. Underclay, medium-gray, fossil roots, coal fragments		3
43. Coal, bright, banded, gypsum crystals, resin blebs		5
44. Shale, medium-gray, thin- to poorly bedded, upper 1 ft 10 in silty	3	6
45. Sandstone, very fine grained, thin-bedded, silty, calcareous, 7-in shale lens 8 in below top; solution cavities, pyrite nodules, fossil roots	3	0
46. Underclay, medium-gray, basal 3 in thin-bedded, silty, shaly	1	0
47. Shale, dark-gray, carbonaceous, few coal fragments		11
48. Shale, medium-gray, thin and evenly bedded, silty, basal 7 in slightly bentonitic; top gradational	6	0
49. Sandstone, very fine grained, thin and irregularly bedded, basal 4½ ft silty; calcareous toward the top	10+	—
Total measured thickness of Mesaverde Formation	78	2

Measured section 9: Cody Shale and Mesaverde Formation

Location: Eagle Point Quadrangle, Wyoming (7.5 min)
Start: NW–NE–SW sec. 29, T. 5 N., R. 1 E. Presented from oldest to youngest
End: NW–SW–SE sec. 29, T. 5 N., R. 1 E.
Described by: R.C. Warlow and J.F. Windolph, Jr.
Strike 80°, Dip 30° SE.

Upper Cretaceous:	Thickness	
Cody Shale:	Ft	in
1. Shale, medium-gray, very fine grained, slightly silty, sandy, and carbonaceous; top gradational, base covered by alluvium	2	0
2. Sandstone, medium-gray to medium-light-gray, very fine grained, thin-bedded, silty, interbedded with siltstone and shale	25	0
3. Sandstone, medium-light-gray, very fine grained, silty, massive, poorly cemented, solution cavities	18	0
4. Shale, medium-gray, thin and evenly bedded, scattered gypsum crystals	9	0
5. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty		5
6. Shale, medium-gray, thin and evenly bedded	1	8
7. Sandstone, medium-gray to medium-light-gray, very fine grained, silty	1	4
8. Shale, medium-gray, thin and irregularly bedded, contains few silty and very fine grained sandstone laminations up to 2 in thick	18	0
9. Sandstone, medium-light-gray, weathers light-grayish-brown, fine-grained, very calcareous, forms resistant ledge		8
10. Shale, medium-gray, thin and evenly bedded, silty, few sandy laminations	1	4
11. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty		5
12. Shale, medium-gray, thin and irregularly bedded, contains abundant thin-bedded, very fine grained sandstone beds mostly 1 to 2 in thick, locally up to 2 ft thick; upper 6 ft grades into very sandy shale with a few medium-dark-gray shale laminations	36	0
Total measured thickness of Cody Shale	113	10
Mesaverde Formation:		
13. Sandstone, light-gray to white, very fine grained, massive, thin- to thick-bedded in upper 7 ft; crossbedded, friable, well-sorted, scattered dark and light mineral grains, few fossil rootlets at top	50	0
14. Sandstone, medium-light-gray, massive, very fine to fine-grained, upper 6 ft slightly silty, calcareous, abundant solution cavities, scattered calcareous nodules	85	0
Base of Maverick Spring coal zone		
15. Coal, dull to bright, thin-banded, scattered resin blebs and gypsum crystals	1	0
16. Tonstein, light-grayish-brown, concoidal fracture, scattered sulfur crystals		1
17. Coal, bright, scattered resin blebs		5
18. Tonstein, weathers white, sulfur-stained		3
19. Coal, impure, abundant shale partings		5
20. Shale, medium-dark-gray, thin and evenly bedded, silty, scattered fossil plant fragments	7	0

	Thickness	
	Ft	in
21. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty		10
22. Shale, medium-gray, thin and evenly bedded		10
23. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, calcareous		11
24. Underclay, medium-gray, thin scattered siltstone interbeds, upper 2 in thin-bedded, very carbonaceous, fossil rootlets	2	6
25. Coal, bright, impure		2
26. Shale, medium-dark-gray to dark-brown, thin-bedded, very carbonaceous	3	0
27. Shale, medium-gray, thin- to poorly bedded, becomes silty toward top	3	4
28. Sandstone, medium-gray to medium-light-gray, very fine grained, thin and irregularly bedded, silty, abundant siltstone interbeds	4	0
29. Sandstone, very fine to fine-grained, thin- to thick-bedded, crossbedded, abundant solution cavities, calcareous, contains 8-in-thick medium-gray shale lens 2½ ft above base	6	0
30. Siltstone, medium-gray, with very fine grained, thin-bedded sandstone interbeds	1	2
31. Shale, medium-gray, thin and evenly bedded; 4-in-thick ironstone band 9 in above base; scattered silty sandstone lenses	6	0
32. Underclay, medium-gray, thin and evenly bedded	1	6
33. Shale, light-grayish-brown, carbonaceous, abundant fossil plant fragments, scattered carbonaceous fragments		5
34. Coal, dull to bright, fine to medium cleats, scattered resin blebs		9
35. Tonstein, light-grayish-brown, elliptical volcanic ash fragments		1½
36. Coal, bright to dull, fine to medium cleats, few thin shale partings, scattered resin blebs		9
37. Shale, medium-grayish-brown, thin and evenly bedded, very carbonaceous, very silty, upper 8 in medium-gray, sandy	1	6
38. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, silty, fossil roots	1	0
39. Underclay, medium-gray, thin-bedded, top gradational; 5-in-thick sandy zone 5 in above base	2	0
40. Sandstone, medium-light-gray, very fine grained, thin to thick interbeds, contains lenses of dark and light mineral grains	12	0
41. Shale, medium-gray, thin-bedded, silty, few fossil rootlets	1	0
42. Shale, medium-dark-gray to light-brownish-gray, very carbonaceous, scattered gypsum crystals, scattered coal laminations	1	8
43. Shale, medium-gray, thin and evenly bedded		6
44. Siltstone, medium-gray, weathered rust-brown, fractured		10
45. Underclay, medium-gray, poorly bedded, silty, fossil rootlets	2	6
46. Coal, impure, few bright laminations, thin-bedded		9
47. Coal, dull to bright, scattered resin blebs, medium cleats		10
48. Shale, light-brownish-gray to medium-dark-gray, thin-bedded	1	4
49. Siltstone, medium-light-gray, weathered, thick-bedded to massive, calcareous		11
50. Shale, medium-dark-gray, scattered fossil rootlets	2	6
51. Shale, light-brownish-gray, thin-bedded, carbonaceous, coal fragments, plant fragments		4
52. Shale, medium-gray to medium-dark-gray; 4-in-thick ironstone band 7 in above base; 8-in-thick very fine grained, silty, sandstone lens 1 ft below top	4	0
53. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty, pyrite nodules	2	0
54. Shale, medium-dark-gray, thin and evenly bedded, slightly carbonaceous		8
55. Tonstein, light-grayish-brown, banded, volcanic skeletal crystalline material		2
56. Underclay, medium-gray, thin-bedded, upper 2 in slightly carbonaceous, scattered fossil rootlets	1	8
57. Coal, bright to dull, medium cleats, scattered resin blebs and gypsum crystals	1	1
58. Shale, medium-gray, thin and evenly bedded, silty	5	0
59. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty		10
60. Underclay, medium-gray, upper 2 in thin-bedded, very carbonaceous, shaly		6
61. Sandstone, medium-light-gray, very fine grained, thin-bedded, crossbedded, silty, calcareous, pyrite nodules, lens-shaped	3	0
62. Shale, medium-gray, thin and irregularly bedded	2	3
63. Sandstone, medium-light-gray, fine-grained, thin-bedded	1	10
64. Underclay, medium-gray, shaly, fossil rootlets		8
65. Coal, bright, fine to medium cleats, scattered gypsum crystals		8
66. Shale, medium-gray, silty, top gradational	1	2
67. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, very calcareous	6	0
68. Underclay, medium-gray, fossil rootlets		10
69. Shale, light-brownish-gray, carbonaceous		10
70. Coal, bright, banded, medium cleats, scattered resin blebs	2	4

	Thickness	
	Ft	in
71. Shale, light-grayish-brown, upper 1 ft 4 in medium-gray, thin and evenly bedded	2	6
72. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, silty, dark and light mineral grains, very calcareous	8	0
73. Shale, light-olive-gray, very sandy		4
74. Coal, dull to bright, finely cleated, scattered resin blebs		4
75. Underclay, dark-grayish-brown, carbonaceous, fossil rootlets, abundant plant fossils, scattered resin blebs	1	2
76. Tonstein, light-grayish-brown, weathers white, banded		1
77. Coal, dull, scattered bright, medium cleats	1	1
78. Sandstone, medium-gray, very fine grained, poorly bedded to nonbedded, very silty		10
79. Shale, medium-dark-gray, thin and evenly bedded	1	3
80. Underclay, dark-grayish-brown, fossil rootlets		4
81. Coal, dull, impure, medium cleats	1	0
82. Shale, medium-gray, thin and evenly bedded		9
83. Siltstone, medium-light-gray, thin- to poorly bedded, scattered pyrite nodules	3	0
84. Sandstone, medium-light-gray, very fine grained, very silty, thin- to poorly bedded, very silty, very calcareous, very iron stained	14	0
85. Underclay, sandy and silty, scattered plant fossils	1	0
86. Sandstone, light-gray to very light gray, thin- to thick-bedded, crossbedded, scattered pyrite nodules, fills channels in unit 85 laterally along outcrop	9	0
87. Underclay, dark-grayish-brown, thin and irregularly bedded, very carbonaceous, scattered plant fossils and coal fragments, scattered fossil rootlets		5
88. Coal, dull, impure, medium cleats, sparse resin blebs	1	1
89. Shale, medium-dark-gray, thin and irregularly bedded, very silty, siltstone band 5 ft above base, carbonaceous in basal 2 in	7	0
90. Siltstone, medium-gray, thin-bedded, calcareous, scattered pyrite nodules	2	1
91. Shale, medium-dark-gray, thin and evenly bedded, scattered plant fossils, slightly silty, becomes carbonaceous toward top	1	6
92. Underclay, dark-grayish-brown, scattered plant fossils, scattered resin blebs, carbonaceous		2
Base of Barquin coal bed		
93. Coal, dull to bright, fine to medium cleats, scattered resin blebs	1	9
94. Tonstein, light-grayish-brown, banded, few phenocrysts, fossil roots, excellent preserved plant fossils		7
95. Coal, dull to bright, fine to medium cleats, scattered resin blebs (Glass and Roberts, 1978, table 2, p. 371)	5	6
96. Underclay, dark-grayish-brown, carbonaceous, abundant plant fossils and coal fragments		4
97. Coal, impure, 30 percent shale partings		5
Top of Barquin coal bed		
98. Tonstein, light-grayish-brown, few phenocrysts, scattered gypsum crystals		2
Top of Maverick Spring coal zone		
99. Shale, dark-grayish-brown, thin and evenly bedded, abundant coal fragments and plant fossils, very carbonaceous		3
100. Shale, medium-gray, thin and evenly bedded, basal 1 ft bentonitic; abundant siltstone laminations in upper 3 ft	7	6
101. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, scattered dark and light mineral grains, very calcareous in upper half; scattered pyrite nodules	8	0
Total measured thickness of Mesaverde Formation	314	½

Measured section 10: Cody Shale through Meeteetse Formation

Location: Eagle Point and Lookout Butte Quadrangles, Wyoming (7.5 min); approximately 1 mi WNW. of the Barquin coal mine

Start: NW–NE–SW sec. 30, T.5 N., R.1 E. Presented from oldest to youngest

End: SW–SE–NW sec. 31, T.5 N., R.1 E.

Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.

Strike 105°, Dip 40° SW.

	Thickness	
Upper Cretaceous:	Ft	in
Cody Shale:		
1. Shale, medium-gray, thin and evenly bedded, with thin sandstone and siltstone interbeds	75	0
Total measured thickness of Cody Shale	75	0
Mesaverde Formation:		
2. Sandstone, light- to medium-gray, ironstained, fine- to medium-grained, solution cavities, scattered pyrite nodules, thick-bedded to massive, crossbedded, resistant	95	0
3. Shale, medium-gray, thin and evenly bedded, interbedded siltstone laminations in upper 2 ft	8	0
4. Sandstone, light-gray, fine-grained, thick-bedded to massive, solution cavities, upper 1 ft contains fossil plant fragments; very resistant	49	0

	Thickness	
	Ft	in
Base of Maverick Spring coal zone		
5. Underclay, light- to medium-brownish-gray, abundant fossil plant material, scattered fossil rootlets		5
6. Coal, finely cleated, mostly bright, sparse resin blebs		10
7. Underclay, light-pinkish-gray to light-brownish-gray, abundant fossil plant material		2
8. Coal, impure, finely cleated, 20 percent laminated shale		7
9. Shale, medium-brownish-gray, thin and irregularly bedded, carbonaceous	1	6
10. Shale, medium-gray, thin and evenly bedded, siltstone laminations	2	0
11. Siltstone, medium-light-gray, thin and irregularly bedded, shale lens 2 in thick 6 in above base; carbonaceous in top 1 in	1	9
12. Sandstone, medium-gray, thin and evenly bedded, very fine to fine-grained, calcareous zones up to 2 in thick; forms resistant ledge	3	0
13. Shale, medium-gray, thin and evenly bedded, siltstone laminations to 1 in thick in upper 1 ft	2	0
14. Shale, medium-purplish-gray, thin and evenly bedded to thin and irregularly bedded, carbonaceous	1	8
15. Shale, medium-gray, thin and evenly bedded		9
16. Siltstone, medium-gray, very calcareous, 20 percent interbedded medium-gray shale	4	2
17. Siltstone, medium-gray, thin and irregularly bedded, very calcareous, sandy, pyrite nodules, iron-stained, forms resistant ledge	3	10
18. Shale, medium-gray, thin and evenly bedded, siltstone laminations up to 1 in thick in middle of unit	2	8
19. Shale, medium-grayish-brown, thin and evenly bedded, carbonaceous	4	0
20. Shale, medium-gray, thin and evenly bedded, thin and irregularly bedded at top	1	0
21. Underclay, medium-gray, scattered fossil plant fragments, scattered fossil rootlets		3
22. Coal, bright, finely cleated, scattered resin blebs, 2-in-thick bone parting 9 in above base	1	4
23. Shale, medium-brownish-gray, thin and irregularly bedded, carbonaceous		6
24. Sandstone, medium-gray, very fine to fine-grained, scattered light and dark mineral grains, thin and irregularly bedded	1	3
25. Shale, medium-gray, thin and evenly bedded	1	3
26. Sandstone, medium-gray, very fine grained, crossbedded, silty, iron-stained, scattered pyrite nodules, very resistant in top 6 in	2	8
27. Shale, medium-gray, thin and evenly bedded, scattered thin siltstone lamination, becomes carbonaceous toward top	1	2
28. Underclay, medium-gray, scattered fossil plant and coal fragments		4
29. Coal, impure, mostly bright, fine-cleated		5
30. Shale, medium-gray, thin and evenly bedded		7
31. Shale, medium-brownish-gray, carbonaceous		5
32. Coal, bright and dull, impure, scattered resin blebs		2
33. Shale, medium-gray, thin and evenly bedded	9	0
34. Shale, thin and evenly bedded, carbonaceous		10
35. Siltstone, medium-gray, thin- to thick-bedded, calcareous, forms resistant ledge	2	6
36. Shale, medium-gray, thin and evenly bedded, 20 percent siltstone laminations	10	8
37. Underclay, dark-brownish-gray, highly weathered, sandy, fossil plant fragments		5
38. Coal, mostly bright, fine to medium cleats		6
39. Shale, medium-gray, thin and evenly bedded	1	2
40. Siltstone, medium-light-gray, thin- to thick-bedded, sandy, very calcareous, iron-stained, carbonaceous shale lenses		8
41. Shale, medium-gray, thin and evenly bedded	2	0
42. Underclay, medium-gray, sandy, fossil plants and coal fragments		8
43. Coal, mostly bright, finely cleated, resin blebs		7
44. Shale, medium-gray, thin and evenly bedded, bentonitic	1	0
45. Sandstone, medium-light-gray, very fine grained, thick and evenly bedded, silty, very calcareous	1	2
46. Shale, medium-gray, thin and evenly bedded, carbonaceous	1	4
47. Siltstone, medium-gray, grades from thin-bedded at base to thick-bedded at top, sandy, calcareous	1	2
48. Shale, medium-gray, thin and evenly bedded	1	8
49. Bentonite, light-gray, soft		2
50. Sandstone, medium-light-gray, fine-grained, massive at base; silty	2	2
51. Shale, medium-gray, thin and evenly bedded, bentonitic in basal half of unit	1	4
52. Underclay, medium-brownish-gray, highly weathered		1
53. Coal, bright, finely cleated		4
54. Shale, medium-brownish-gray, plant fossils, carbonaceous		3
55. Shale, medium-gray, thin and evenly bedded		4
56. Siltstone, medium-gray, calcareous, sandy		4

	Thickness Ft	Thickness in
57. Shale, medium-gray, thin and irregularly bedded		6
58. Siltstone, medium-gray, thin and irregularly bedded, sandy		5
59. Underclay, medium-brownish-gray, fossil plant fragments and resin blebs		6
60. Coal, mostly bright, fine to medium cleats, resin blebs	1	2
61. Shale, medium-gray, thin and evenly bedded		10
62. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, silty	1	0
63. Shale, medium-gray, thin and evenly bedded, siltstone laminations up to ½ in thick	4	0
64. Underclay, medium-brownish-gray, highly weathered fossil plant fragments up to ½ in thick		6
65. Coal, bright, fine to medium cleats, resin blebs	1	6
66. Shale, medium-gray, thin and evenly bedded		9
67. Siltstone, medium-gray, thin and irregularly bedded	20	4
Top of Maverick Spring coal zone		
68. Sandstone, light-medium-gray, fine-grained, iron-stained, thick-bedded, very calcareous, resistant	3	0
69. Sandstone, medium-gray, thick-bedded to massive, crossbedded, light and dark mineral grains, pyrite nodules, solution cavities	55	0
70. Shale, medium-gray, thin and evenly bedded	6	4
71. Sandstone, medium-light-gray, fine-grained, light and dark mineral grains, thick-bedded to massive, crossbedded, pyrite nodules	20	6
72. Shale, medium-gray, thin and evenly bedded	1	4
73. Underclay, medium-brownish-gray, highly weathered, plant fossil fragments		4
74. Coal, dull, very impure, highly weathered		8
75. Shale, medium-gray, thin and irregularly bedded, bentonitic in basal 2 in		8
76. Sandstone, medium-gray, fine-grained, thick and irregularly bedded, crossbedded, nonresistant, iron-stained, very calcareous, pyrite nodules	11	0
77. Shale, medium-gray, thin and evenly bedded		8
78. Sandstone, medium-light-gray, fine-grained, several thin shale laminations, thin and irregularly bedded, massive, calcareous laminations, resistant beds	44	0
79. Shale, medium-gray, thin and evenly bedded	7	6
80. Underclay, medium-brownish-gray, fossil plant material		4
81. Coal, very impure, dull, weathered		2
82. Bentonite		1
83. Sandstone, fine- to medium-grained, light-medium-gray, light and dark mineral grains, thick-bedded to massive, solution cavities, pyrite nodules	25	10
84. Sandstone, medium-gray, thin and evenly bedded	5	2
85. Underclay, medium-brownish-gray, fossil rootlets, very weathered		4
86. Coal, dull to bright, fine cleats, highly weathered		6
87. Sandstone, very fine grained, thin and irregularly bedded, silty, calcareous, iron-stained	1	4
88. Shale, medium-gray, thin and irregularly bedded, thin sandstone laminations	2	0
89. Underclay, medium-brownish-gray, abundant plant fossils		3
90. Coal, dull to bright, impure		4
91. Shale, medium-gray, thin and irregularly bedded, bentonitic		10
92. Siltstone, medium-light-gray, thin and evenly to irregularly bedded, very calcareous	1	6
93. Shale, medium-gray, thin and evenly bedded	1	0
94. Underclay, medium-gray, abundant fossil plant material and rootlets		4
95. Coal, dull to bright, fine cleats, highly weathered		1
96. Bentonite and shale, light-gray		2
97. Sandstone, light- to medium-gray, fine- to medium-grained, thick-bedded, solution cavities, pyrite nodules	22	6
98. Shale, medium-gray, thin and evenly bedded	4	8
99. Sandstone, medium-gray, fine-grained, iron-stained, thick-bedded to massive, solution cavities, pyrite nodules	38	0
100. Shale, medium-gray to medium-brownish-gray, becomes carbonaceous in top part of unit; thin siltstone laminations at basal contact		8
101. Siltstone, medium-gray, thin-bedded		8
102. Shale, medium-gray, thin and evenly bedded, becomes carbonaceous toward top		10
103. Sandstone, fine- to medium-grained, thin- to thick-bedded, scattered pyrite nodules, thin shale lenses 1 to 2 in thick	64	2
104. Shale, medium-gray, thin and evenly bedded, grades carbonaceous at top		8
105. Underclay, medium-brownish-gray, abundant fossil plant material		6
106. Coal, very impure, highly weathered		3
107. Sandstone, light-medium-gray, very fine grained, thin-bedded, thin shale laminations	8	6
108. Shale, thin-bedded, few siltstone laminations, carbonaceous toward top, sandy	9	10
109. Sandstone, medium-light-gray, fine-grained, thin-bedded, pyrite nodules, solution cavities	1	4
110. Shale, thin and evenly bedded, sandy,		

		Thickness	
		Ft	in
	siltstone laminations, carbonaceous in basal 6 in	10	2
111.	Sandstone, very fine grained, light and dark mineral grains, iron-stained, pyrite nodules, very calcareous, solution cavities	9	0
112.	Shale, basal 7 in carbonaceous, upper 3 in medium-gray, thin and evenly bedded		10
113.	Sandstone, medium-gray, very fine grained, iron-stained, thin and irregularly bedded, calcareous, resistant ledges	10	0
114.	Shale, medium-gray, thin and evenly bedded		10
115.	Siltstone, medium-gray, very calcareous, thin and irregularly bedded	5	10
116.	Shale, medium-gray, thin and evenly bedded, carbonaceous in middle part with 7-in bentonitic zone	5	8
117.	Sandstone, very fine grained, iron-stained, scattered pyrite nodules, solution cavities, very calcareous, scattered thin shale laminations in 10 percent of unit	33	4
118.	Siltstone, medium-gray, iron-stained, very calcareous, thin and irregularly bedded	16	4
119.	Sandstone, light-medium-gray, very fine to fine-grained, iron-stained, solution cavities, pyrite nodules, thin to thick and irregularly bedded, crossbedded, calcareous	22	8
120.	Shale, medium-gray, thin and evenly bedded, carbonaceous in upper 3 ft	4	6
121.	Sandstone, medium-gray, very fine grained, silty, very calcareous, pyrite nodules, resistant	5	10
122.	Shale, medium-gray, thin and evenly bedded		6
123.	Underclay, medium-brownish-gray, highly weathered		4
124.	Coal, highly impure, dull, highly weathered		2
125.	Sandstone, medium-gray, very fine to fine-grained, thin-bedded; fossil plants in basal 10 in, thin and irregularly bedded, very calcareous, iron-stained	5	2
126.	Shale, medium-gray, thin and evenly bedded to thin and irregularly bedded, sandy, few thin siltstone laminations	16	2
127.	Sandstone, medium-gray, very fine to fine-grained, 5 percent thin and evenly bedded, iron-stained, crossbedded, pyrite nodules, shale laminations, solution cavities in basal portion, resistant	65	6
128.	Shale, medium-gray, thin and evenly bedded	4	2
129.	Sandstone, light-medium-gray, very fine grained, fossil plants, solution cavities	10	2
130.	Shale, medium-gray, thin and evenly bedded, carbonaceous in top 4 in	1	0
131.	Sandstone, medium-gray, fine-grained, pyrite nodules, iron-stained solution cavities, 10 percent thin shale laminations interbedded with 15 percent calcareous siltstone	38	0
132.	Shale, medium-gray, thin and evenly bedded, carbonaceous in upper 3 ft 2 in	9	6
133.	Sandstone, medium-gray, very fine to fine-grained, fossil plant fragments; basal 2 ft 2 in thin and irregularly bedded, very calcareous; upper 8 in thin bedded; pyrite nodules, crossbedded	2	10
134.	Shale, medium-gray, thin and evenly bedded	2	0
135.	Siltstone, thin and irregularly bedded, highly calcareous, iron-stained	1	2
136.	Shale, medium-gray, thin and evenly bedded, carbonaceous in top 3 in	2	10
137.	Sandstone, light- to medium-gray, fine-grained, silty, thin and irregularly to evenly bedded, crossbedded	4	0
138.	Shale, underclay, medium-brownish-gray, thin and irregularly bedded, fossil plant material, carbonaceous		10
139.	Coal, mostly bright, fine to medium cleats, resin blebs		10
140.	Shale, medium-brownish-gray, carbonaceous		3
141.	Sandstone, light-medium-gray, very fine grained, pyrite nodules thick- to thin-bedded, 10 percent shale laminations; resistant calcareous ledges	13	0
142.	Shale, medium-gray, thin and evenly bedded	1	2
143.	Underclay, medium-grayish-brown, highly weathered, abundant fossil plants		3
144.	Coal, very impure, highly weathered		7
145.	Sandstone, light- to medium-gray, medium-grained, light and dark mineral grains, thick-bedded to massive, iron-stained, solution cavities, crossbedded, resistant calcareous, concretions up to 2 ft in length	60	6
146.	Shale, medium-gray, thin and irregularly bedded	8	2
147.	Siltstone, light-gray, thin to thick and irregularly bedded	2	6
148.	Sandstone, medium gray, fine grained, massive	8	0
149.	Shale, bentonitic, carbonaceous in upper 1½ ft	2	4
150.	Sandstone, medium-gray, fine-grained, thin and irregularly bedded, pyrite nodules, very calcareous	9	8
151.	Shale, medium-gray, thin and evenly bedded	5	0
152.	Siltstone, medium-gray, very calcareous, sandy, thin sandstone laminations in upper half of unit; carbonaceous in upper third of unit	11	10
153.	Sandstone, fine-grained, thin to thick and irregularly bedded, crossbedded, iron-stained, pyrite nodules, resistant, calcareous concretions	24	4
154.	Shale, medium-gray, thin and evenly bedded	5	3

		Thickness	
		Ft	in
155.	Sandstone, light- to medium-gray, fine- to medium-grained, light and dark mineral grains, thin and irregularly bedded, crossbedded		10
156.	Shale, medium-gray, thin and evenly bedded, 10 percent thin calcareous siltstone laminations	4	8
157.	Sandstone, medium-light-gray, very fine grained, silty, very calcareous, thin and evenly bedded, siltstone in medial part, basal 3 ft thin and evenly bedded; 8-in-thick shale bed 1 ft below top; thick bedded and resistant at top	9	0
158.	Shale, medium-gray, thin and evenly bedded, very carbonaceous basal part		4
159.	Underclay, medium-brownish-gray, fossil plant material	1	6
160.	Siltstone, medium-gray, thin and irregularly bedded, highly weathered	1	6
161.	Sandstone, medium-gray, fine-grained, iron-stained, pyrite nodules thin- to thick-bedded, crossbedded	5	4
162.	Shale, medium-gray, thin and evenly to thin and irregularly bedded, carbonaceous, bentonite in top 1 ft	5	8
163.	Sandstone, light- to medium-gray, fine-grained, thin and irregularly bedded	1	6
164.	Shale, medium-gray, thin and evenly bedded, thin calcareous siltstone laminations in upper 2 ft	13	4
165.	Sandstone, light- to medium-gray, fine- to medium-grained, light and dark mineral grains, thick- to thin-bedded, solution cavities, pyrite nodules, very calcareous	5	6
166.	Shale, medium-gray, thin and evenly bedded, very carbonaceous in upper 8 in	6	6
167.	Sandstone, light- to medium-gray, very fine grained, calcareous, thin and irregularly bedded, scattered pyrite nodules	9	8
168.	Shale, medium-gray, thin and evenly bedded	4	2
169.	Siltstone, very calcareous in base, iron-stained, thin and evenly bedded, thin and irregularly bedded in upper 8 in	1	6
170.	Sandstone, fine-grained, silty, pyrite nodules, solution cavities, resistant	5	0
171.	Shale, medium-gray, thin and evenly bedded		10
172.	Sandstone, fine-grained, light and dark mineral grains, thick- to thin-bedded, shale lens 2 ft above base	8	10
173.	Shale, medium-gray, thin and evenly bedded, basal 5 in carbonaceous	5	10
174.	Sandstone, medium-gray, very calcareous, thin-bedded, iron-stained		8
175.	Shale, basal 2 in carbonaceous, siltstone laminations in medial part	1	2
176.	Sandstone, fine-grained, light and dark mineral grains, thin and irregularly bedded, solution cavities, resistant	1	4
177.	Shale, medium-gray, thin and evenly bedded		8
178.	Underclay, medium-brownish-gray, fossil plant material		10
179.	Sandstone, very fine to fine-grained, silty, pyrite nodules very calcareous, solution cavities, siltstone laminations in basal 3 ft	8	10
180.	Shale, medium-gray, thin and evenly bedded	1	4
181.	Sandstone, fine-grained, iron-stained, scattered pyrite nodules, solution cavities, calcareous, basal portion thin-bedded	17	0
182.	Sandstone, light- to medium-gray, medium-grained, light and dark mineral grains, thin-bedded to massive,solution cavities, pyrite nodules, resistant, very calcareous, crossbedded	40	0
183.	Shale, medium-gray, thin and evenly bedded, carbonaceous	5	2
184.	Sandstone, light- to medium-gray, fine-grained, thin and irregularly bedded, fossil plants, pyrite nodules	1	4
185.	Shale, medium-gray, thin and evenly bedded	3	2
186.	Sandstone, light- to medium-gray, fine-grained, thin and irregularly bedded, fossil plants, pyrite nodules	1	8
187.	Shale, medium-gray, thin and evenly bedded, upper 1 ft 4 in has calcareous siltstone laminations	2	8
188.	Sandstone, light- to medium-gray, fine- to medium-grained, thick-bedded, pyrite nodules, solution cavities, very calcareous; 6-in-thick shale lens 3 ft above base	20	0
189.	Shale, medium-gray, thin and evenly bedded, carbonaceous in upper 6 ft 11 in, siltstone laminations in upper 3 ft 5 in	10	4
190.	Siltstone, thin and irregularly bedded, very calcareous	1	6
191.	Sandstone, medium-gray, fine- to medium-grained, thick-bedded, pyrite nodules, solution cavities, resistant, calcareous	5	2
192.	Shale, medium-gray, thin and evenly bedded	2	2
193.	Sandstone, light-gray, medium-grained, light and dark mineral grains, scattered pyrite nodules, iron-stained, noncalcareous	4	6
194.	Shale, medium-gray, thin and evenly bedded, 6-in sandstone laminations 2 ft below top	6	2
195.	Siltstone, medium-gray, thin-bedded, calcareous	1	6
196.	Sandstone, fine-grained, light and dark mineral grains, solution cavities, fossil plants		10
197.	Shale, medium-gray, thin and evenly bedded		10
198.	Sandstone, fine- to medium-grained, light and dark mineral grains, thin to thick and irregularly bedded, solution cavities, pyrite nodules, calcareous	5	0

		Thickness	
		Ft	in
199.	Shale, medium-gray, thin and evenly bedded	5	0
200.	Sandstone, light- to medium-gray, fine-grained, light and dark mineral grains, thin- to thick-bedded, calcareous siltstone in basal third of unit; pyrite nodules, solution cavities	13	0
201.	Shale, medium-gray, thin and evenly bedded	3	0
202.	Underclay, medium-brownish-gray, fossil plant material		8
203.	Shale, medium-gray, thin evenly bedded	2	4
204.	Shale, medium-brownish-gray, carbonaceous		2
205.	Coal, impure, detrital, transported		1
206.	Sandstone, light- to medium-gray, very fine to fine-grained, thin- to thick-bedded, pyrite nodules, solution cavities	1	0
207.	Shale, medium-gray, thin and evenly bedded, becomes carbonaceous in top half of unit		8
208.	Sandstone, medium-gray, very fine grained, silty, iron-stained, pyrite nodules, fossil plants		10
209.	Shale, medium-gray, thin and irregularly bedded to thin and evenly bedded, siltstone laminations, upper third of unit calcareous, resistant	6	6
210.	Sandstone, medium-gray, very fine to fine-grained, thin- to thick-bedded, pyrite nodules, iron-stained, solution cavities	3	0
211.	Shale, medium-gray, thin and evenly bedded, siltstone laminations, upper 3 ft of unit calcareous, resistant	11	4
212.	Sandstone, fine-grained, thick-bedded, scattered pyrite nodules, iron-stained, solution cavities, crossbedded	5	4
213.	Shale, medium-gray, thin and evenly bedded	1	0
214.	Underclay, medium-brownish-gray, fossil plants, coal fragments		5
215.	Shale, medium-gray, thin and evenly bedded, thin calcareous siltstone interbeds	1	2
216.	Siltstone, medium-gray, thin and irregularly bedded		9
217.	Sandstone, very fine to fine-grained, thick-bedded, iron-stained, pyrite nodules, solution cavities, resistant	4	6
218.	Shale, medium-gray, thin and evenly bedded	4	6
219.	Underclay, medium-brownish-gray, fossil plant material		10
220.	Shale, medium-brownish-gray, thin and evenly bedded, carbonaceous		8
221.	Shale, medium-gray, thin and evenly bedded	5	10
222.	Sandstone, medium-gray, very fine to fine-grained, thin- to thick-bedded, silty, iron-stained, pyrite nodules, very calcareous	11	4
223.	Shale, medium-gray, thin and evenly bedded, sandstone lamination interbeds	15	10
224.	Sandstone, medium-gray, medium-grained, light and dark mineral grains, thick-bedded to massive, iron-stained, pyrite nodules, solution cavities, upper 8 ft light-gray, thin and irregularly bedded	35	0
225.	Shale, medium-gray, thin and evenly bedded	6	6
226.	Sandstone, medium-gray, very fine grained, iron-stained, pyrite nodules; lens of shale 6 in thick, calcareous siltstone laminations in lower third of unit, resistant	20	4
227.	Shale, medium-gray, thin and evenly bedded		10
228.	Underclay, medium-brownish-gray, fossil plant material, highly weathered		1
229.	Coal, bright to dull, highly weathered, impure		2
230.	Sandstone, light- to medium-gray, fine-grained, light and dark mineral grains, lower 3 ft thin-bedded, nonresistant, upper 2 ft thick-bedded to massive	5	0
231.	Shale, medium-brownish-gray, carbonaceous, thin and irregularly bedded		5
232.	Sandstone, light- to medium-gray, medium-grained, light and dark mineral grains, iron-stained, pyrite nodules, solution cavities, crossbedded; 6-in-thick shale lens 10 in above base	4	2
233.	Siltstone, medium-gray, thin and irregularly bedded, mostly nonresistant, basal 4 in shale lens; calcareous laminations, resistant	9	4
234.	Sandstone, fine- to medium-grained, light and dark mineral grains, thick-bedded, pyrite nodules, solution cavities, crossbedded	1	2
235.	Shale, medium-gray, thin and evenly bedded	6	2
236.	Sandstone, fine-grained, thin and irregularly bedded, iron-stained, very calcareous		10
237.	Shale, medium-gray, thin and evenly bedded	10	6
238.	Sandstone, medium-gray, very fine to fine-grained, thin and irregularly bedded, iron-stained, fossil plants, very calcareous, resistant	1	4
239.	Shale, medium-gray, thin and evenly bedded	6	6
240.	Sandstone, medium-gray, very fine grained, thin-bedded, iron-stained, very calcareous, pyrite nodules, resistant		10
241.	Shale, medium-gray, thin and evenly bedded	1	6
242.	Sandstone, light- to medium-gray, very fine to fine-grained, iron-stained, solution cavities, pyrite nodules, very calcareous, resistant	11	6
243.	Shale, medium-gray, thin and evenly bedded, calcareous siltstone, laminations in upper 7 in	1	8

		Thickness	
		Ft	in
244.	Sandstone, medium-gray, very fine grained, silty, iron-stained, scattered pyrite nodules, calcareous	5	0
245.	Shale, medium-gray, thin and evenly bedded, sandy	6	4
246.	Sandstone, fine- to medium-grained, thin- to thick-bedded, crossbedded, basal 3 ft interbedded siltstone and shale laminations, calcareous, solution cavities, resistant	10	8
247.	Shale, medium-gray, thin and irregularly bedded	6	6
248.	Sandstone, light-medium-gray, very fine to fine-grained, thin-bedded, pyrite nodules, very calcareous, solution cavities	1	6
249.	Shale, medium-gray, thin and evenly bedded	1	2
250.	Underclay, light- to medium-brownish-gray, abundant fossil plants		7
251.	Shale, medium-gray, thin and irregularly to thin and evenly bedded, calcareous, 5-in-thick zone of siltstone laminations in middle part of unit	2	0
252.	Sandstone, light- to medium-gray, very fine to fine-grained, thin and irregularly bedded, pyrite nodules, slightly calcareous	55	8
253.	Shale, medium-gray, thin and evenly bedded		6
254.	Underclay, medium-brownish-gray, abundant fossil plants, coal fragments		4
255.	Coal, bright, bony		5
256.	Shale, medium-gray, thin and evenly bedded		6
257.	Sandstone, light- to medium-gray, fine-grained, light and dark mineral grains, thin- to thick-bedded, resistant, crossbedded	2	4
258.	Shale, gray, thin and evenly bedded, carbonaceous in upper 6 in	1	4
259.	Sandstone, medium-gray, fine- to medium-grained, very calcareous, thin and irregularly bedded, pyrite nodules	4	8
260.	Shale, medium-brownish-gray, thin and irregularly bedded, carbonaceous	4	0
261.	Siltstone, medium-gray, weathered	1	4
262.	Shale, medium-gray, thin and evenly bedded, sandy, carbonaceous in lower 2 ft	11	4
263.	Sandstone, medium-gray, fine-grained, thin- to thick-bedded, iron-stained, pyrite nodules, crossbedded, solution cavities	8	10
264.	Shale, medium-gray, thin and evenly bedded		10
265.	Sandstone, light- to medium-gray, fine-grained, thick-bedded to massive, pyrite nodules, calcareous, solution cavities	40	0
266.	Shale, medium-gray, thin and evenly bedded	15	2
267.	Sandstone, light- to medium-gray, fine- to medium-grained, thin- to thick-bedded, pyrite nodules, solution cavities, crossbedded	9	2
268.	Shale, medium-gray, thin and evenly bedded, few thin, siltstone laminations, calcareous	20	4
269.	Sandstone, light- to medium-gray, fine- to medium-grained, thin- to thick-bedded, pyrite nodules, crossbedded, solution cavities very calcareous	24	0
270.	Shale, medium-gray, thin and evenly bedded, grades into carbonaceous, alternating siltstone and shale laminations in upper 2 ft	6	0
271.	Sandstone, medium-gray, fine-grained, iron-stained, thick-bedded, pyrite nodules, very calcareous, resistant	6	2
272.	Shale, upper 4 ft medium-blue-gray, lower 2 ft medium-olive-gray, thin and irregularly bedded	6	0
273.	Shale, medium-green-gray, thin and irregularly bedded, sandy	1	2
274.	Shale, upper 7 in medium-gray; lower 7 in light- to medium-olive-gray; thin and irregularly bedded	1	2
275.	Sandstone, fine- to medium-gray, massive, blocky, solution cavities, crossbedded	25	6
276.	Shale, lower 3 ft medium-olive-gray, next 1 ft dark-bluish-gray, remainder medium-gray	9	4
277.	Siltstone, medium-gray, thin and irregularly bedded to thin and evenly bedded, resistant, interbedded, light-gray, very fine grained, sandstone laminations	42	0
	Total measured thickness of main body of Mesaverde Formation	1,842	1
	White sandstone member:		
278.	Sandstone, light- to medium-gray, dark and light mineral grains, clean, well-sorted, thick-bedded to massive, pyrite nodules, crossbedded, solution cavities; 8-in-thick grayish-red shale, lens-shaped bed, 51 ft above base; 6-in-thick grayish-red shale bed, thin and irregularly bedded, 10-in gray, thin and evenly bedded shale bed and 6-in red, thin and irregularly bedded shale bed 87 ft above base; zone of thin-bedded, iron-stained siltstone and sandstone; mostly sandstone, light-gray, 104 ft above base	104	0
279.	Sandstone, white to light-gray, clean, well-sorted, thick-bedded to massive, very fine to fine-grained	190	0
	Total measured thickness of white sandstone member	294	0
	Total measured thickness of Mesaverde Formation	2,136	1
	Meeteetse Formation:		
280.	Shale, medium-gray, thin and irregularly bedded	1	10
281.	Sandstone, light-gray, thin-bedded, fine- to medium-grained, interbeds of iron-		

	Thickness Ft	Thickness in
stained, resistant, sandstone laminations	10	0
Valley bottom—end of section, covered by alluvium	—	—
Total measured thickness of Meeteetse Formation	10	10

Measured section 11: Cody Shale and Mesaverde Formation

Location: Morton Quadrangle, Wyoming (7.5 min)
Start: NE–SW–SW sec. 13, T. 3 N., R. 1 W. Presented from oldest to youngest
End: SW–NE–SW sec. 13, T. 3 N., R. 1 W. Partial section
Described by: J.F. Windolph, Jr.
Strike 140°, Dip 18° NE.

	Thickness Ft	Thickness in
Upper Cretaceous:		
Cody Shale:		
1. Shale, medium-dark-gray to medium-gray, thin and evenly bedded, few thin siltstone and sandstone interbeds, very silty	94	11
2. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, slump-bedded, silty	4	4
3. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, slightly carbonaceous	5	7
4. Sandstone, medium-light-gray, fine-grained, thick-bedded, few pyrite nodules		10
5. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, slightly carbonaceous	2	6
6. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to mostly massive	22	4
7. Shale, medium-dark-gray, very fine grained, thin and evenly bedded, few thin sandstone interbeds	4	0
8. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, crossbedded, silty	1	6
9. Shale, medium-gray, 10 percent very fine grained, sandstone with siltstone interbeds, few thin ripple beds, very silty; 8-in-thick sandstone 8 ft above base, and 10-in-thick sandstone 18 ft above base	27	11
10. Sandstone, medium-light-gray, fine-grained, thick-bedded, pyrite nodules	1	1
11. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, silty	6	0
12. Sandstone, medium-light-gray, fine-grained, thick-bedded	1	1
13. Shale, medium-gray, thin and evenly bedded	3	0
14. Sandstone, medium-light-gray, fine-grained, massive, few scattered shale chips, upper 1 ft thin-bedded, calcareous	22	4
15. Shale and sandstone interbedded each about 50 percent; shale medium thin, evenly bedded, ripple bedded, silty, scattered coal fragments, scattered raindrop prints and animal tracks, about 20 percent sandstone interbeds in upper 35 ft	55	10
16. Sandstone, medium-light-gray, very fine to fine-grained, silty in basal 1 ft, upper 3 ft thin-bedded, calcareous; 2 ft above base, massive and friable in 1-ft-4-in-thick friable zone	5	4
17. Shale, medium-gray, very silty at base	4	0
18. Sandstone, medium-light-gray, very fine grained, thin-bedded	1	4
19. Shale, medium-gray, thin and evenly bedded, very silty, sandy	2	0
20. Sandstone, medium-light-gray, very fine grained, thin-bedded, crossbedded, silty	4	0
21. Shale, medium-gray, nonbedded	3	0
22. Sandstone, medium-light-gray, very fine grained, thick-bedded, silty		8
23. Shale, medium-gray, thin and evenly bedded, very silty, sandy	1	4
24. Sandstone, medium-light-gray, very fine grained, thin-bedded, calcareous	4	0
25. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, few shale interbeds, silty	22	4
Strike 160°, Dip 20° NE.		
Note: Contact between Cody Shale and Mesaverde Formation is at the top of 22 ft 4 inches in unit 25 and consists of an approximately 2-ft zone of sandstone, coarse grained, granular, few pebbles, upper ¼ in grayish-red bentonitic shale.		
Total measured thickness of Cody Shale	301	3
Mesaverde Formation:		
26. Sandstone, light-gray, very fine to medium-grained, thin-bedded, crossbedded, massive, friable, solution cavities, pyrite nodules, upper 4–5 ft very calcareous, base poorly exposed	42	8
27. Sandstone, fine-grained, very friable, massive, forms topographic depression, scattered shale chips	22	4
Bottom of Maverick Spring coal zone		
28. Underclay, medium-gray, basal 5 ft thin-bedded, silty, upper part slightly bentonitic	9	2
29. Shale, medium-dark-gray, thin and evenly bedded, carbonaceous	1	10
30. Shale, medium-gray, thin and evenly bedded, silty	4	6
31. Sandstone, medium-light-gray, very fine to fine-grained, thin and evenly bedded, slightly calcareous	16	9

	Thickness Ft	in
32. Underclay, medium-gray, nonbedded, fossil rootlets	5	7
33. Shale, light-grayish-brown, thin-bedded, very carbonaceous with scattered coal fragments, scattered fossil plant fragments, few scattered fossil rootlets	8	
Kinnear coal bed		
34. Coal, bright attritus, fine cleats, banded, fusain, sulphur-stained	1	2
35. Tonstein, light-grayish-brown, flattened ash particles at base		¾
36. Coal, weathered, bright attritus, banded; cleated	1	2
37. Tonstein, very light grayish brown, scattered carbonaceous fragments, flattened ash particles at base		5
38. Shale, dark-brown, very carbonaceous, scattered coal fragments		2
39. Shale, medium-gray to light-gray, silty, grades upward to sandstone, appears to contain volcanic ash		4
40. Sandstone, medium-gray, very fine grained, very silty, shaly, iron-stained	2	6
41. Sandstone, medium-light-gray, fine-grained, thin and irregularly bedded with crossbeds, shale, chips, small pyrite nodules, few medium grains at base	22	4
Section poorly exposed from this point to the base of the Wind River conglomerate, and tuff beds approximately 800 ft to the northeast.		
Total measured thickness of Mesaverde Formation	131	7¾

Measured section 11a: Mesaverde Formation (Part)

Location: Morton Quadrangle (7.5 min)
Start: SE–SW sec. 13, T. 3 N., R. 1 W. Presented from oldest to youngest
End: SW–SE sec. 13, T. 3 N., R. 1 W.
Described by: J.F. Windolph, Jr.
Strike 142°, Dip 22° NE.

	Thickness Ft	in
Upper Cretaceous:		
Mesaverde Formation:		
1. Sandstone, medium-light-gray to light-gray, grades thin-bedded and crossbedded to massive, solution cavities	14	6
2. Shale, light-brownish-gray to medium-gray, thin-bedded, silty	2	3
Base of Kinnear coal bed (A coal bed)		
3. Coal, bright, finely cleated, slightly impure, scattered shale fragments	1	1
4. Tonstein, light-brownish-gray, flattened volcanic ash particles at base		¾
5. Coal, bright		10
6. Shale, light-brownish-gray, thin-bedded, silty, carbonaceous	1	2
7. Coal, bright, upper 2 in impure, shaly, bony		6
8. Shale, medium-dark-gray, poorly bedded		5
9. Coal, impure, shaly at base		2
Top of Kinnear coal bed (A coal bed)		
10. Shale, medium-gray, thin and evenly bedded		6
11. Sandstone, medium-light-gray, very fine to fine-grained, crossbedded, silty, scattered fossil plant leaves	1	10
12. Siltstone, medium-gray, thin and irregularly bedded, thin sandstone interbeds	2	6
13. Sandstone, medium-light-gray, very fine grained, crossbedded, silty, fossil root penetrations		11
14. Shale, medium-gray, bentonitic, few scattered fossil rootlets in upper 1 ft, very carbonaceous at top	5	0
15. Coal, weathered, impure		3
16. Shale, medium-gray, thin and evenly bedded	6	0
17. Limestone, medium-gray, nonbedded, brittle, fractured	2	0
18. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, ripple-bedded, very calcareous	15+	
Note: Sandstones are very lenticular.		
Total measured thickness of Mesaverde Formation	54	3/

Measured section 12: Fort Union Formation

Location: Shotgun Butte Quadrangle, Wyoming (7.5 min)
Start: SW–NE–SW sec. 35, T. 6 N., R. 1 E. Presented from oldest to youngest
End: NW–NE–SW sec. 2, T. 5 N., R. 1 E.
Described by: J.F.Windolph, Jr.
Strike 90°, Dip 35° N.

	Thickness Ft	in
Paleocene:		
Fort Union Formation:		
Shotgun Member:		
1. Shale, light-olive-brown, thin-bedded, bentonite	3+	
2. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thin- to thick-bedded, lenticular beds	20	0
3. Shale, medium-gray, silty, slightly bentonitic	5	0
4. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, thick-bedded to massive, crossbedded, fractures filled with quartz, friable	32	0
5. Shale, medium-gray, poorly bedded, few fossil roots, slightly bentonitic, partly covered	95	0
6. Sandstone, medium-light-gray, fine-grained, massive	5	0
7. Shale, medium-gray to medium-dark-gray, slightly bentonitic, poorly bedded	12	0

	Thickness	
	Ft	in
8. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded, few fossil roots at top	9	0
9. Shale, medium-gray to medium-dark-gray, thin-bedded	18	0
10. Sandstone, medium-light-gray, granular, fine- to medium-grained, basal 1 ft very coarse, thin-bedded, slightly calcareous, current bedding, top friable	8	0
11. Shale, medium-gray, thin and evenly bedded, silty	8	0
12. Sandstone, medium-light-gray to medium-gray, fine-grained, silty, thin and irregularly bedded, calcareous	9	0
13. Shale, light-olive-gray, poorly bedded, partly covered	36	0
14. Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, thin-bedded to massive, slump-bedded, crossbedded, few shale lenses near top, few fossil plant impressions	22	0
15. Shale, medium-gray to light-olive-gray, silty, thin- to poorly bedded	15	0
16. Sandstone, medium-light-gray, very fine grained, silty, thick-bedded	8	0
17. Shale, light-olive-gray, nonbedded, silty	25	0
18. Shale, light-olive-gray, very fine grained, silty, thin and irregularly bedded, crossbedded	25	0
19. Shale, light-olive-gray, silty, slightly bentonitic, upper 5 ft light-grayish-brown, slightly carbonaceous, thin-bedded	55	0
20. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, calcareous, upper 2 ft light-gray	25	0
21. Shale, light-olive-gray, bentonitic; 6-in-thick, fine-grained sandstone 55 ft above base; 1-ft-thick, fine-grained sandstone 70 ft above base; upper 20 ft very silty, few pyrite nodules	78	0
22. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded	6	0
23. Shale, medium-dark-gray to medium-gray, thin-bedded	7	0
24. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded		6
25. Shale, medium-gray to light-olive-gray, thin-bedded	15	0
26. Sandstone, medium-light-gray, very fine grained, thin-bedded	2	0
27. Shale, light-olive-gray to medium-dark-gray, thin-bedded	15	0
28. Sandstone, medium-light-gray, fine-grained, thin and irregularly bedded, contains few shale interbeds, silty	10	0
29. Shale, light-olive-gray to light-grayish-brown to medium-dark-gray, thin-bedded	8	0
30. Sandstone, medium- to medium-light-gray, fine-grained, thin-bedded to massive, crossbedded, few silty shale interbeds, top calcareous	7	6
31. Shale, light-olive-gray, thin-bedded; 4-in-thick sandstone lens 4½ ft above base; 6-in-thick sandstone lens 10 ft above base	12	0
32. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, fossil roots at top	2	6
33. Shale, light-olive-gray, poorly bedded	7	0
34. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, thin-bedded to massive, crossbedded	7	6
35. Underclay, medium-gray, nonbedded, few fossil rootlets in upper 4 in, silty, sandy	1	8
36. Shale, grayish-brown, thin-bedded, abundant fossil plant fragments, coal fragments, very carbonaceous, gypsum crystals, good fossil impressions	3	0
37. Sandstone, medium-light-gray, very fine grained, silty, shaly lens-shaped interbeds, top part becomes silty	2	0
38. Shale, light-olive-gray to medium-gray, very silty	3	6
39. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, massive to thin-bedded, slump-bedded, friable, solution cavities	11	0
40. Shale, light-olive-gray to medium-gray, thin-bedded, silty, contains 5-in-thick medium-dark-gray carbonaceous zone 1½ ft below top	6	0
41. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, lens-shaped beds	5	0
42. Shale, light-olive-gray, poorly bedded	5	0
43. Shale, brown, thin- to poorly bedded, few fossil roots, very carbonaceous, sulfur-stained, gypsum crystals; 2-in-thick impure coal 1 ft above base; 3-in-thick shaly coal 2½ ft above base; 1-in-thick impure coal 4 ft above base; 1-ft-thick medium-gray underclay 3 ft above base	6	0
44. Sandstone, medium-gray, very fine grained, silty, shaly, contains abundant silt and shale interbeds	6	0
45. Shale, light-olive-gray, nonbedded	10	6
46. Sandstone, medium-gray, very fine grained, thin-bedded, silty, calcareous, contains pyrite nodules in top	2	0
47. Shale, medium-gray, thin and evenly bedded, contains a few siltstone and sandstone lenses up to 1 ft thick, becomes medium-gray and silty in upper 2 ft	15	0
48. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, thin-bedded	1	6
49. Shale, medium-gray to light-olive-gray, thin-bedded	3	6
50. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, few shale lenses	3	6

		Thickness	
		Ft	in
51.	Shale, light-olive-gray, pyrite nodules, silty; 8-in-thick siltstone 16 ft above base; 6-in-thick sandy siltstone 25 ft above base; becomes slightly bentonitic and sandy in top part	47	0
52.	Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, slump-bedded	10	0
53.	Shale, light-olive-gray, contains few thin beds, light-grayish-brown carbonaceous streaks and zones	7	0
54.	Sandstone, fine-grained, lens-shaped bedding, thick-bedded, friable	1	10
55.	Shale, light-grayish-brown, carbonaceous, thin-bedded		2
56.	Tonstein, flattened volcanic ash particles, fossil plant fragments and impressions, abundant fibrous gypsum		10
57.	Shale, light-grayish-brown, thin-bedded, silty, gypsum crystal, coal fragments, volcanic ash particles		3
58.	Tonstein, medium-gray, thin-bedded to nonbedded, excellent fossil leaf impressions, fossil plant fragments, fibrous gypsum, volcanic ash particles		5
59.	Sandstone, medium-light-gray, very fine to fine- to medium-grained, thin-bedded to massive, crossbedded, silty and carbonaceous laminations, calcareous, solution cavities	15	0
60.	Shale, medium-gray, poorly bedded; 1-ft-thick sandstone lens 6 ft above base; 6-in-zone of silty pyritic nodules 14 ft above base; 1-ft-thick sandstone 18 ft above base, becomes very silty, sandy with siltstone-sandstone interbeds 25 ft above base; 1-ft-thick fine-grained sandstone 30 ft above base; top 1 ft, light-grayish-brown, thin-bedded, very carbonaceous, gypsum crystals	41	0
61.	Sandstone, medium-light-gray, fine-grained, thin-bedded, few shale laminations	8	0
62.	Shale, light-olive-gray, nonbedded	9	0
63.	Shale, dark-gray, thin-bedded, very carbonaceous	1	6
64.	Coal, impure bony, bright		5
65.	Shale, light-olive-gray, nonbedded	2	6
66.	Shale, light-grayish-brown, thin-bedded, very carbonaceous, coal fragments	3	6
67.	Shale, very light grayish brown, basal 3 ft of upper part light-olive-gray, nonbedded, fossil rootlets in upper 1 ft	6	0
68.	Shale, grayish-brown, thin-bedded, basal 5 in very bony, abundant coal fragments, gypsum crystals, very carbonaceous, fossil plant fragments	2	0
69.	Shale, light-olive-gray, thin-bedded at base, poorly bedded at top, upper 2 ft very silty	4	4
70.	Sandstone, medium-light-gray, very fine to fine-grained, silty, thin-bedded, crossbedded, upper 3 ft massive	2	0
71.	Shale, medium-gray, silty, sandy, 4-in slightly carbonaceous zone 1½ ft above base; thin- to poorly bedded upward, 2-ft silty and sandy zone 5 ft above base; 1½ ft silty zone with fossil roots 17 ft above base; fossil rootlets in upper 1 ft, nonbedded	34	0
72.	Shale, grayish-brown, very carbonaceous, thin-bedded, abundant coal laminations and fragments, sulfur stains, gypsum crystals		10
73.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, few silty shale beds	4	0
74.	Shale, light-brownish-gray, basal 1 ft slightly carbonaceous, very silty, sandy, slightly bentonitic light-olive-gray; very bentonitic upward, top becomes silty	29	0
75.	Sandstone, medium-light-gray, very fine grained to fine-grained, thin-bedded to massive, silty, solution cavities, calcareous concretions up to 1 ft in diameter, fossil roots in top of unit	6	0
76.	Shale, light-olive-green, thin-bedded, bentonite; upper 6 in carbonaceous, thin-bedded, medium-dark-gray	5	6
77.	Sandstone, very fine to fine-grained, thin-bedded, crossbedded, few shale interbeds, top becomes silty	16	0
78.	Shale, medium-gray, poorly bedded	4	6
79.	Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	2	6
80.	Shale, medium-gray, poorly bedded	30	0
81.	Shale, light-grayish-brown, carbonaceous, thin and evenly bedded, few thin olive-gray interbeds	6	0
82.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded to massive, lens-shaped bedding, crossbedding, solution cavities	7	0
83.	Shale, light-olive-gray, thin-bedded, silty, partly covered, slightly bentonitic	40	0
84.	Shale, grayish-brown, thin-bedded, silty, very carbonaceous, sulphur-stained, coal fragments, and laminations		10
85.	Shale, light-olive-gray, thin- to poorly bedded	1	0
86.	Shale, grayish-brown, very coaly, carbonaceous		3
87.	Shale, partly covered, light-olive-green, poorly bedded, bentonite	25	0
88.	Sandstone, partly covered, medium-light-gray, fine-grained, thick-bedded	15	0
89.	Shale, light-olive-gray, poorly bedded, bentonite	15	0
90.	Shale, grayish-brown, thin-bedded, very carbonaceous, coal fragments	4	0
91.	Shale, medium-gray, thin-bedded	5	0
92.	Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, contains few light-olive-gray shale lenses	32	0

	Thickness	
	Ft	in
93. Underclay, medium-gray, silty, sandy, fossil rootlets		6
94. Shale, light-grayish-brown to light-olive-gray upward, very carbonaceous, sulfur stains, coal laminations	5	0
95. Shale, light-olive-gray, thin-bedded, fossil rootlets in upper 6 in	11	0
96. Shale, brownish-gray, coal fragments, thin-bedded		3
97. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	8
98. Shale, medium-gray, poorly bedded, few fossil rootlets		10
99. Shale, brownish-gray, abundant coal fragments at base and in top 4 in	2	6
100. Sandstone, medium-light-gray, very fine grained, silty, abundant carbonaceous shale laminations; 1-ft zone of pyrite nodules at top	4	0
101. Shale, light-olive-gray, bentonite, poorly bedded	8	0
102. Shale, light-grayish-brown, thin-bedded, very carbonaceous, abundant fossil plant fragments, few coal fragments, sulfur stains	2	9
103. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, slump-bedded, fossil roots at top, thick-bedded	2	0
104. Shale, medium-gray to very light brownish gray, nonbedded	2	6
105. Shale, brownish-gray, thin-bedded, very coaly, carbonaceous, coal laminations, sulphur-stained	3	4
106. Shale, medium-gray, bentonitic, contains 1-ft-thick sandy zone 10 ft above basal contact	13	0
107. Sandstone, medium-light-gray, very fine to fine-grained, few shale interbeds, thin- to thick-bedded, fossil roots	4	2
108. Shale, medium-gray to light-olive-gray, nonbedded, silty, slightly bentonitic	13	0
109. Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, few siltstone interbeds, abundant fossil roots	5	6
110. Shale, light-olive-green, nonbedded, becomes silty upward	7	0
111. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	6
112. Shale, light-olive-gray to very light grayish brown, thin-bedded	2	10
113. Sandstone, medium-light-gray, very fine grained, silty, friable, solution cavities, thin-bedded to massive, lens-shaped beds, crossbedded	5	8
114. Shale, light-olive-gray, thin-bedded, upper 1 ft slightly carbonaceous	5	6
115. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, pyrite nodules, calcareous	2	0
116. Underclay, medium-gray, fossil roots, silty		6
117. Shale, light-grayish-brown, carbonaceous, thin-bedded	1	2
118. Shale, medium-gray, poorly bedded	1	0
119. Shale, very light grayish brown, very carbonaceous, thin-bedded, fossil plant impressions, upper 1 ft silty and sandy	1	10
120. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded to massive, crossbeds	11	0
121. Shale, light-olive-gray, poorly bedded, silty, partly covered	33	0
122. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded to massive, slump-bedded, lens-shaped beds, few siltstone interbeds	13	0
123. Shale, light-olive-gray, poorly bedded, slightly carbonaceous in upper 1 ft	6	0
124. Sandstone, medium-light-gray, very fine grained, silty, very friable	10	0
125. Shale, medium-gray, poorly bedded, bentonitic, 1-ft-thick sandy zone 5 ft above basal contact, becomes light-olive-gray upward	22	0
126. Sandstone, medium-gray, very fine grained, very silty, thick-bedded, crossbedded	7	6
127. Shale, light-olive-gray to medium-gray, upper 2 ft very silty, few fossil roots, slightly carbonaceous	7	0
128. Shale, grayish-brown, thin and evenly bedded, carbonaceous, few coal fragments		6
129. Shale, light-olive-gray to light-grayish-brown, slightly carbonaceous, thin and evenly bedded	4	0
130. Sandstone, medium-gray, very fine grained, very silty, thin and evenly bedded, crossbedded, siltstone laminations	4	0
131. Shale, medium-gray to olive-gray, nonbedded, top becomes silty	8	6
132. Sandstone, medium-light-gray, very fine to fine-grained, silty, friable, thin-bedded to massive, upper 3 ft calcareous	12	0
133. Shale, light-olive-gray, poorly bedded; 4-in-thick silty sandstone 8 ft above base; 2-ft-thick silty sandstone 12 ft above base; 2-ft-thick siltstone 13 ft above base	20	0
134. Sandstone, medium-gray, very fine grained, very silty, lens-shaped bedding, calcareous lenses; 3-ft-thick shale lens 3½ ft above base, thin-bedded to massive	10	0
135. Shale, light-olive-gray, a few 1-ft-thick sandstone lenses in basal 2 ft; becomes olive-green upward; top very sandy	13	0
136. Sandstone, medium-gray, very fine grained, silty, thin-bedded	7	0
137. Shale, light-olive-gray, poorly bedded	12	0
138. Shale, light-grayish-brown, carbonaceous, few siltstone-sandstone interbeds, fossil plant fragments	3	0

	Thickness	
	Ft	in
139. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	1	0
140. Shale, olive-gray, nonbedded	5	0
141. Sandstone, medium-light-gray, very fine grained, silty, thick-bedded	3	0
142. Shale, light-olive-gray, silty, poorly bedded	9	6
143. Sandstone, medium-light-gray, fine-grained, thin high-angle crossbedding	5	0
144. Shale, medium-gray to light-olive-gray, thin-bedded	8	0
145. Sandstone, medium-gray, very fine to fine-grained, thick-bedded, few fossil roots	1	6
146. Shale, medium-gray to light-olive-gray, thin-bedded	9	0
147. Sandstone, medium-light-gray, fine-grained, thick-bedded, crossbedding	95	0
148. Shale, light-olive-gray, medium-dark-gray silt, poorly bedded	18	0
149. Sandstone, medium-light-gray, very fine grained, silty, few shale lenses, thick-bedded	5	0
150. Shale, light-olive-gray, nonbedded	12	0
151. Sandstone, fine- to medium-grained, thin-bedded to massive, crossbedded	25	0
152. Shale, light-olive-gray, very silty, poorly bedded, nonbedded, silty nodules in upper 3 ft	5	6
153. Sandstone, medium-gray to medium-light-gray; conglomeratic; lenses of rounded quartz pebbles, sandstone pebbles, shale chips, and petrified wood, up to 1½ inches in diameter, silty shale; crossbedded and thin bedded to massive, friable, upper 3 ft calcareous	13	0
154. Shale, light-olive-gray, basal 8 ft very sandy with sandstone lenses 1 ft thick, thin-bedded	16	0
155. Sandstone, medium-light-gray, very fine to fine-grained, lens-shaped and thick-bedded to massive	8	0
156. Shale, medium-gray to dark-olive-gray, bentonitic, nonbedded	31	0
157. Sandstone, medium-gray to medium-light-gray, very silty, very fine grained, thin- to thick-bedded, crossbedded, few shale lenses, shale chips, unit becomes granular and conglomeratic 15 ft above base, top 8 ft massive	25	0
158. Shale, medium-gray to light-olive-gray, basal 3 ft very sandy, silty, thin-bedded; 1-ft-thick sandstone bed 36 ft above base, nonbedded above 36 ft, bentonitic; 1-ft-thick silty sandstone 60 ft above base; 2-ft-thick silty sandstone 80 ft above base	95	0
159. Sandstone, medium-light-gray, very fine to fine-grained, few granules, crossbedded, massive, lenses of conglomerate up to 1 ft thick at base; 5 ft above base pebbles are up to 1½ inch in diameter	12	0
160. Shale, medium-gray to medium-light-gray, very sandy	2	6
161. Sandstone, medium-light-gray, very fine grained, silty	1	2
162. Shale, medium-gray to light-olive-green, nonbedded, upper 2 ft grayish-red, thin and evenly bedded	26	0
Total measured thickness of Shotgun Member	1,889	0
Total measured thickness of Fort Union Formation	1,889	0

Measured section 13: Cody Shale through Indian Meadows Formation

Location: Jenkins Mountain Quadrangle, Wyoming (7.5 min)
Start: NE–SE–NW sec. 24, T. 6 N., R. 2 E. Presented from oldest to youngest
End: NW–SW–SE sec. 6, T. 5 N., R. 3 E.
Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.
Strike 65°, Dip 30° SE.

	Thickness	
Upper Cretaceous:	Ft	in
Cody Shale:		
1. Shale, medium-dark-gray, thin interbeds, very silty, becomes sandy upward	10+	
2. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, silty	31	6
3. Sandstone, medium-gray, very fine grained, thin-bedded, silty, very shaly, few thin, resistant beds	53	0
4. Shale, medium-dark-gray, thin and evenly bedded, sandy, silty, resistant, thin-bedded sandstone lenses; becomes sandy at top	38	0
5. Sandstone, medium-light-gray, very fine grained, dark and light grains, weathered, generally nonresistant; 5-ft-thick resistant ledge at 25 ft above base; 3-ft-thick resistant ledge at 51 ft above base; 1-ft-thick shale lens 1 ft below top of unit	56	0
6. Shale, medium-dark-gray, grades to medium-gray upward, thin and evenly bedded, a few dark-gray shale interbeds; 1-ft-thick sandstone lenses 6 ft and 8 ft above base	14	0
7. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, very silty, very calcareous	2	7
8. Shale, medium-gray, very silty, sandy, thin silt interbeds; 3-in dark-gray shale 5 ft above base; nonsilty above 5 ft	14	6
9. Sandstone, medium-light-gray, very fine grained, few fine grains, thin-bedded, dark and light grains, silty, very calcareous	2	4

	Thickness	
	Ft	in
10. Shale, medium-dark-gray, thin and evenly bedded; 1-ft-thick silty sandstone beds 4½ ft above base, 7½ ft above base, 11 ft above base, 13 ft above base, 22 ft above base, 31 ft above base, 37 ft above base (thin-bedded, calcareous), and 47 ft above base; lens 47 ft above base; also contains several thin limestones; friable; more shaly 50 ft above base	115	0
11. Covered, probably shale	35	0
12. Siltstone, medium-gray, very fine grained, medium-dark-gray shale interbeds	4	6
Total measured thickness of Cody Shale	376	5
Mesaverde Formation:		
13. Sandstone, medium-light-gray, very fine grained, thin to thick and irregularly bedded, silty, slightly calcareous, pyrite nodules, siltstone lenses up to 1 in thick, solution cavities 10 ft below top contact	50	0
14. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, contains several very fine grained silty sandstone interbeds up to 1 ft thick	12	0
15. Sandstone, medium-light-gray, very fine grained, crossbedded, very silty, pyrite nodules, very calcareous, 6-in-thick shale lens 2 ft above base, thin and irregularly bedded; 1-ft-thick shale lens 6 ft above base	12	6
16. Covered, probably medium-gray shale	25	0
17. Shale, medium-dark-gray, thin and evenly bedded	3+	
18. Sandstone, very fine grained, thin- to thick-bedded, slightly silty, very calcareous, pyrite nodules, few shale lenses 2 ft above base; solution cavities, scattered siltstone lenses	100	0
19. Sandstone, light-grayish-brown, very fine grained, thin and irregularly bedded, very silty, very carbonaceous, scattered fossil plants	4	6
20. Shale, grayish-brown, thin and evenly bedded, silty, sulphur-stained, contains coalified tree trunk, very carbonaceous		10
21. Sandstone, light-gray, very fine to fine-grained, thick-bedded, dark and light mineral grains		10
22. Shale, medium-gray, thin- to poorly bedded, few fragments of fossil plant stems and roots	1	6
23. Shale, dark-grayish-brown, thin and evenly bedded, abundance of coal fragments, gypsum crystals		3
Base of Maverick Spring coal zone		
24. Coal, bright, resin blebs, gypsum crystals, thick bands, fine cleats		10
25. Shale, medium-gray, thin- to poorly bedded, few thin siltstone lenses and very fine grained sandstone interbeds, few limestones and thin calcareous beds; 4-in-thick, very fine grained nodular sandstone 17 ft above base, becomes very shaley above 17 ft; 3-ft-thick silty shale and very fine grained sandstone 25 ft above base; 45 ft above base very silty thin-bedded, very fine grained sandstone interbeds; top of unit becomes sandy and grades into unit 26	65	0
26. Sandstone, medium-light-gray, very fine grained, thick-bedded to massive, few crossbeds, petroleum stain at base; very silty and friable in lower 10 ft; very fine to fine-grained 10 ft above base; pyrite nodules, solution cavities, very calcareous; thin bedded at top	65	0
27. Shale, medium-dark-gray to medium-gray, thin and evenly bedded, gypsum crystals; upper 1 ft contains few fossil rootlets	19	6
28. Shale, grayish-brown, thin-bedded, silty, abundant coal fragments and laminations, very carbonaceous	2	8
29. Underclay, medium-gray, nonbedded, silty and sandy at top, fossil rootlets	7	0
30. Coal, bright to dull, impure, shale bands, resin blebs volcanic ash bands, gypsum crystals, fine to medium cleats; 4-in-thick tonstein 4 in above base		8½
31. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, coal fragments, basal 3 in very carbonaceous with thin ash bed; 1-ft-thick calcareous siltstone 2 ft above base	6	6
32. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, slightly calcareous	1	5
33. Underclay, medium-gray, nonbedded, fossil rootlets	1	3
34. Shale, light-grayish-brown, thin-bedded, silty, sandy, very carbonaceous		7
35. Coal, impure, thin-bedded, shaly		3
36. Shale, light-grayish-brown, thin-bedded, very carbonaceous, abundant fossil plant material, coal fragments, gypsum crystals, few fossil rootlets in upper part	1	11
37. Coal, impure, bony, banded, resin blebs, medium-cleats, thin volcanic ash interbeds		4
38. Shale, medium-dark-gray, thin and evenly bedded, slightly carbonaceous		7
39. Siltstone, medium-gray, thin- to poorly bedded	3	2
40. Shale, medium-gray, poorly bedded, few fossil roots	1	6
41. Sandstone, light-gray, very fine grained, thick-bedded, fossil roots at top, silty, dark and light mineral grains		10

	Thickness	
	Ft	in
42. Underclay, medium-gray to medium-dark-gray, few fossil roots in upper 6 in, slightly carbonaceous	3	0
43. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, silty, very silty in basal 3 in; dark and light mineral grains	2	6
44. Shale, medium-gray, silty, thin-bedded, upper 1 ft contains coalified log, few fossil rootlets	2	2
45. Sandstone, very fine grained, thin- to thick-bedded, silty, dark and light mineral grains, very calcareous, small pyrite nodules	2	8
46. Shale, medium-gray, thin and evenly bedded, coal fragments	3	0
47. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty	1	10
48. Underclay, medium-gray, fossil roots, poorly bedded	3	0
49. Coal, impure, resin blebs, thin volcanic ash bands, fine cleats		6½
50. Shale, medium-dark-gray, thin-bedded	2	6
51. Sandstone, light-gray to very light gray, very fine grained, thin and irregularly bedded, fossil roots at top, very silty	5	0
52. Shale, medium-gray, thin-bedded, slightly silty, very carbonaceous, upper 8 in brownish-gray	9	2
53. Coal, bright, fine to medium cleats, banded	1	7
54. Shale, medium-gray, thin- to thick-bedded, upper 3 in very carbonaceous, black, sooty	2	10
55. Coal, bright; 4-in-thick shaly zone 5 in above base; unit locally channeled and filled by overlying sandstone	1	5
Top of Maverick Spring coal zone		
56. Sandstone, light-gray to very light gray, very fine grained, thin- to thick-bedded, crossbedded, silty, very slightly calcareous, pyrite nodules, ironstone lenses, massive-bedded in lower 10 ft; solution cavities	25	0
57. Shale, medium-gray, siltstone lens 5 ft above base	15	0
58. Underclay, medium-gray to light-grayish-brown, fossil roots, gypsum crystals, upper 4 in very carbonaceous, silty	1	9
59. Coal, bright to dull, fusain, resin blebs, few thin shale partings	1	2
60. Shale, medium-gray, nonbedded, silty, few fossil plant fragments, hard, contain volcanic ash beds	1	1
61. Sandstone, very light gray, very fine grained, irregularly bedded, top grades shaly	3	6
62. Underclay, medium-light-gray, fossil rootlets, silty	1	10
63. Shale, light-grayish-brown, abundant carbonaceous material, coal fragments, very fine grained sandstone laminations		4
64. Coal, bright		3
65. Tonstein, very light brownish gray, scattered fossil plants, carbonaceous matter		1
66. Coal, bright, abundant fusain at top, top channeled and filled by unit 67		7
67. Sandstone, very light gray, ironstone, very fine to fine-grained, very calcareous, high-angle crossbeds, pyrite nodules	12	0
68. Shale, medium-gray, thin and evenly bedded, upper 6 in very carbonaceous	7	0
69. Coal, bright, resin blebs, slightly bony		4
70. Shale, light-grayish-brown, silty, thin-bedded, very carbonaceous, fossil plant fragments	1	0
71. Coal, bright, fine to medium cleats, resin blebs, cleats 170° at vertical and 55° at 55° NW.	2	4
72. Shale, medium-gray, thin-bedded, silty	2	4
73. Sandstone, light-gray, very fine grained, thin-bedded, ironstone, pyrite nodules, very calcareous	10	0
74. Shale, medium-gray, thin and evenly bedded, silty, 2-in-thick impure coaly zone 3 ft above base	18	0
75. Sandstone, light-gray, very fine grained, thin-bedded, very silty	2	10
76. Shale, medium-gray, thin and evenly bedded	12	0
77. Sandstone, very light gray to white, very fine grained, silty, pyrite nodules, fossil roots	4	0
78. Underclay, medium-dark-gray to medium-gray, nonbedded, slightly bentonitic, fossil rootlets, upper 6 in very carbonaceous, silty, coal fragments	2	4
79. Coal, bright, fine cleats, soft weathered, top channeled and filled by sand, unit 80	2	4
80. Sandstone, light-gray, fine-grained, crossbedded, thin-bedded, abundant dark and light mineral grains, very calcareous	6	0
81. Shale, medium-gray, bentonitic in basal 3 ft, few silty zones, ironstone bands	16	0
82. Sandstone, very light gray, very fine grained, thin and irregularly bedded, locally crossbedded, iron-stained, very calcareous, silty in top 2 ft	18	0
83. Shale, medium-dark-gray to medium-gray, thin and evenly bedded, very silty in upper 2 ft, very carbonaceous in upper 1 ft, a few fossil rootlets and plant fragments throughout	5	0
84. Coal, bright, resin blebs, fine to medium cleats, upper 1 in few volcanic ash laminations		10
85. Shale, medium-gray to light-brownish-gray, lower 5 in and upper 5 in very carbonaceous and thin-bedded; middle part of unit contains fossil roots and is nonbedded	1	9
86. Coal, bright		3

	Thickness	
	Ft	in
87. Shale, light-brownish-gray, thin-bedded, very carbonaceous, coal fragments, resin blebs		4
88. Coal, bright, ¼-in-thick white volcanic ash bed in middle part		6
89. Shale, light-brown to medium-gray, thin and evenly bedded		7
90. Sandstone, light-gray, very fine grained, very silty, thin- to thick-bedded	5	0
91. Shale, medium-gray, thin- to poorly bedded, slightly carbonaceous		7
92. Sandstone, light-gray, very fine grained, very silty, very iron stained, very silty in basal 2 in	6	0
93. Shale, medium-gray to light-brownish-gray, thin and evenly bedded, slightly carbonaceous	1	2
94. Underclay, medium-gray, bentonitic, nonbedded, fossil rootlets	1	0
95. Coal, bright		5
96. Shale, light-gray to light-brownish-gray, thin and evenly bedded, upper 1 ft slightly bentonitic; fossil roots, poorly bedded at top	1	8
97. Shale, medium-gray to light-brownish-gray, thin and evenly bedded, upper 1 ft slightly bentonitic; fossil roots, poorly bedded at top	3	4
98. Shale, light-brownish-gray, carbonaceous, thin-bedded, coal, fossil plant fragments, resin blebs		6
99. Coal, bright		6
100. Shale, medium-gray, top becomes silty and sandy, thin and evenly bedded	1	4
101. Sandstone, light-gray, very fine grained, silty, crossbedded, pyrite nodules, ironstone lenses	4	0
102. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, basal 1 ft 2 in very carbonaceous; few ironstone nodules in upper 1 ft	3	0
103. Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty, iron-stained, calcareous	3	6
104. Shale, medium-gray, thin and evenly bedded, upper 4 in very carbonaceous; 1-ft-thick nonbedded zone with fossil roots 4 in below top	3	8
105. Coal, bright, fine to medium cleats, upper 4 in shaly and bony, gypsum crystals		11
106. Shale, medium-gray, thin- to poorly bedded	1	2
107. Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty	2	0
108. Shale, medium-gray, thin and evenly bedded, contains 1-ft-thick siltstone 1 ft 4 in above base; scattered thin sand interbeds	15	0
109. Sandstone, very light gray, very fine grained, thin and irregularly bedded	12	0
110. Underclay, medium-gray, poorly bedded, 4-in-thick carbonaceous zone 5 ft above base	13	0

	Thickness	
	Ft	in
111. Sandstone, light-gray, very fine to fine-grained, thin and irregularly bedded, locally crossbedded, iron-stained, very calcareous, pyrite nodules	10	0
112. Shale, medium-gray, thin and evenly bedded; 2-ft-thick siltstone 3 ft above base; 6-in-thick dark-gray carbonaceous shale 6 ft above base; 1-ft-2-in-thick siltstone lens 11 ft above base	20	0
113. Siltstone, calcareous, light-gray, thin and irregularly bedded	1	4
114. Sandstone, light-gray, very fine grained, thick to thin and irregularly bedded, calcareous, dark and light mineral grains, limestone laminations 2 ft above base	4	0
115. Shale, medium-gray, very fine grained, thin and evenly bedded, very silty, sandstone interbeds	7	6
116. Sandstone, light-gray, very fine grained, iron-stained, thin- to thick-bedded, locally crossbedded, very calcareous; 1-ft-thick medium-gray shale lens 6 ft below top	21	0
117. Shale, medium-gray, in basal 2 ft; grades into light grayish brown for next 2½ ft; grades into poorly bedded, silty and sandy, medium-gray shale in upper 4 ft	8	6
118. Sandstone, very light gray to white, very fine grained, thin and irregularly bedded, very silty, pyrite nodules	2	5
119. Shale, medium-gray; 10-in-thick siltstone 1½ ft above base; overlain by 2 ft of light-brownish-gray shale with coal fragments; upper 1 ft is light brownish gray, carbonaceous shale	7	6
120. Siltstone, light-gray, thin-bedded, sandy, very calcareous, weathered, blocky	1	3
121. Shale, medium-gray, thin and evenly bedded	2	0
122. Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty, pyrite nodules	1	6
123. Shale, medium-gray, poorly bedded; 2-in-thick coaly carbonaceous zone 4 ft above base; 1½-ft-thick sandy, calcareous siltstone 5 ft above base; 2½-ft-thick light-brownish-gray, silty, carbonaceous shale at top with gypsum crystals, resin blebs, and coal fragments, few fossil roots	11	0
124. Coal, bright, slightly impure, resin blebs, fine to medium cleats, upper 8 in bony	1	8
125. Sandstone, very light gray to white, very fine grained, thin and irregularly bedded, silty	2	0
126. Shale, medium-gray, thin and evenly bedded, silty to very silty; 1-ft-thick silty ironstone 4 ft above base	12	0
127. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, crossbedded, very silty; 6-in-thick shale lens 3 ft above base; pyrite nodules	16	0

	Thickness	
	Ft	in
128. Shale, medium-gray, silty, thin and evenly bedded, upper 2 in bentonitic	1	8
129. Coal, bright		2
130. Shale, medium-gray, thin and evenly bedded	1	2
131. Sandstone, very light gray to white, very fine grained, thin- to thick-bedded, crossbedded, very silty, very calcareous, pyrite nodules	6	0
132. Shale, medium-gray, thin and evenly bedded, upper 1½ ft very sandy and silty with coal fragments; upper 3 in very carbonaceous, shaly	5	6
133. Coal, impure		3
134. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, few siltstone interbeds	7	0
135. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, dark and light mineral grains, very calcareous, solution cavities	18	0
136. Shale, medium-light-gray in basal 10 in, very silty and sandy, upper part light-gray-brown, very carbonaceous	1	2
137. Coal, dull, weathered, fine cleats, resin blebs		7
138. Shale, medium-gray, thin and evenly bedded, scattered thin silt interbeds	4	0
139. Sandstone, very light gray, very fine grained, thick- to massive-bedded, silty, dark and light mineral grains, scattered carbonaceous material, very calcareous	12	6
140. Shale, medium-gray, thin- to poorly bedded, very silty; 1-ft-thick siltstone 1 ft above base; few carbonaceous zones in upper 3 ft	22	0
141. Sandstone, light-gray, very fine to fine-grained, crossbedded, thin- to thick-bedded, slightly calcareous, iron-stained	8	0
142. Shale, medium-gray, thin- to poorly bedded, few sandy and silty zones; 1-in-thick coaly bed 10 ft above base	17	0
143. Sandstone, light-gray, very fine grained, thin and irregularly bedded, crossbedded, slightly calcareous, iron-stained, limestone in top 1 ft, pyrite nodules	10	0
144. Shale, medium-gray, thin-bedded, sandy, silty, has 1-ft-thick siltstone lens 16 ft above base; becomes more silty and sandy upward	26	0
145. Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty, iron-stained	1	0
146. Shale, medium-gray, thin and evenly bedded; 1-ft-3-in-thick carbonaceous coaly zone 2 ft above base	5	6
147. Sandstone, light-gray, very fine grained, thin- to thick-bedded, dark and light mineral grains, calcareous, iron-stained; 6-in-thick shale lens 2 ft above base	15	0
148. Shale, medium-gray, thin and evenly bedded, upper 1 ft bentonitic fossil roots	4	0
149. Coal, impure, weathered		4
150. Shale, medium-gray, thin and evenly bedded, upper 8 in light-grayish-brown, with abundant coal fragments, fossil roots, silty	6	0
151. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	2	0
152. Shale, medium-gray, thin- to poorly bedded, silty, few fossil roots	1	4
153. Coal, bright, impure		4½
154. Shale, medium-gray, thin- to poorly bedded, abundant siltstone and sandstone interbeds; basal 5 in very carbonaceous; upper 1½ ft very sandy, thin bedded	6	0
155. Shale, medium-gray, thin and evenly bedded, basal 1 ft very sandy; upper 3 in very carbonaceous	2	6
156. Bentonite, light-olive-gray, nonbedded, few fossil roots in upper 2 in with few coal fragments	3	0
157. Shale, medium-gray, thin and evenly bedded	1	3
158. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, silty		8
159. Shale, medium-gray to medium-dark-gray, lower half thin-bedded, upper half nonbedded	5	0
160. Sandstone, medium-light-gray, very fine grained, thick-bedded, silty, few fossil roots at top	2	6
161. Shale, medium-gray, thin-bedded, silty, few coal fragments	1	8
162. Siltstone and sandstone, medium-gray; sandstone, very fine grained, contains 6-in-thick medium-gray shale interbed	2	0
163. Shale, medium-gray to medium-dark-gray, thin and evenly bedded, few carbonaceous zones	4	0
164. Limestone, medium-gray, brittle, fractured; 8-in-thick very fine grained sandstones at base, overlain by 1-ft-4-in-thick medium-gray, thin-bedded shale	6	0
165. Shale, medium-gray; upper 1 ft, medium dark gray, thin and evenly bedded; few coal fragments in upper 7 in	3	0
166. Shale, medium-gray, thin and evenly bedded, very silty, sandy	1	1
167. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, silty, upper 8 in contains ironstone nodules and shale	3	0
168. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	2	6
169. Sandstone, medium-light-gray, very fine grained, silty	1	4
170. Shale, medium-gray to medium-dark-gray, thin and evenly bedded	2	6
171. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded; 4-in-thick shaly, coaly, sooty lens 4 ft above base; upper half very calcareous	22	6

	Thickness	
	Ft	in
172. Shale, medium-gray, few thin, medium- and dark-gray carbonaceous shale interbeds; few very fine grained sandstone interbeds up to 1 ft thick	11	0
173. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	3	6
174. Shale, medium-gray, thin-bedded, silty	1	6
175. Shale, light-grayish-brown, very carbonaceous, silty, abundant coal fragments	2	3
176. Shale, medium-gray, thin-bedded, silty, sandy, upper 6 in carbonaceous	1	4
177. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	1	3
178. Shale, medium-gray, thin and poorly bedded	2	10
179. Sandstone, medium-light-gray, very fine grained, silty, thin siltstone-shale in basal 1 ft	2	10
180. Shale, medium-gray, poorly bedded, silty, few fossil roots	2	0
181. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, very calcareous, few shaly interbeds in basal 2 ft; ironstone and pyrite nodules	25	0
182. Shale, medium-gray to light-grayish-brown, thin-bedded, upper 2 ft poorly bedded, few fossil roots	7	6
183. Shale, light-grayish-brown to brown, very carbonaceous, silty, coaly, abundance of fossil plant fragments	7	6
184. Shale, medium-gray, poorly bedded, contorted lens-shaped beds, possible fault zone	4	0
185. Sandstone, medium-light-gray, medium- to fine-grained, thin and irregularly bedded, silty	4	0
186. Shale, medium-gray in basal 1½ ft, upper part grayish-brown, a few fossil rootlets, silty	5	0
187. Coal, impure, shaly		6
188. Shale, medium-gray, thin and evenly bedded		8
189. Sandstone, light-gray, very fine to fine-grained, thin-bedded, very calcareous, pyrite nodules, fossil roots in upper part	6	0
190. Shale, medium-gray to dark-gray, poorly bedded, fossil roots, upper 4 in very carbonaceous	3	6
191. Sandstone, medium-light-gray, fine- to very fine grained, thin and irregularly bedded, crossbedded, basal 4 in very friable, upper part very calcareous	17	0
192. Shale, medium-gray, thin-bedded, upper 2½ ft very carbonaceous, fossil plant fragments	5	0
193. Sandstone, light-gray, very fine to fine-grained, massive-bedded, dark and light mineral grains, solution cavities, basal 3 ft contains calcareous concretions	10	0
194. Shale, medium-gray to dark-gray, thin and evenly bedded, silty, few carbonaceous laminations at base and top	3	6
195. Sandstone, basal 3 ft thin-bedded, very silty, upper part very fine grained, massive	8	0
196. Underclay, medium-gray, sandy, silty, fossil rootlets	1	0
197. Coal, brown, banded, abundance of fusain		6
198. Shale, light-grayish-brown		7
199. Shale, medium-gray, thin-bedded		5
200. Limestone, medium-gray, brittle, fractured	1	3
201. Shale, medium-gray, thin-bedded	2	6
202. Sandstone, light-gray in basal 5 ft, medium-light-gray in top 3 ft, very fine to fine-grained, massive-bedded	8	0
203. Underclay, medium-gray, fossil roots	2	6
204. Shale, grayish-brown, thin-bedded, very carbonaceous, coal fragments		8
205. Coal, brownish-gray, resin blebs, fine to medium cleats		8
206. Shale, medium-gray, silty in upper 4 ft, slightly bentonitic, top channeled and filled by unit 207	5	0
207. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, very calcareous	17	6
208. Shale, medium-gray, thin and evenly bedded; 1-ft-thick ironstone lens 6 in above base; 3-in-thick carbonaceous zone 6½ ft above base; 1½-ft-thick carbonaceous zone 3½ ft below top	33	0
209. Sandstone, medium-light-gray, light mineral grains, silty, very calcareous, upper 8 in very calcareous	5	0
210. Shale, medium-gray, thin and evenly bedded, abundance of calcareous ironstone and scattered sandstone lenses; 3-in-thick limestone at base; scattered sandstone lenses; 1-ft-thick sandstone lense 20 ft above base; 3-in-thick carbonaceous shale 6 in below top contact	31	0
211. Sandstone, medium-light-gray, thin-bedded, silty	1	10
212. Shale, medium-gray, thin and evenly bedded, silty	2	6
213. Shale, medium-gray to dark-grayish-brown, abundant coal fragments near top	4	6
214. Shale, medium-gray to light-grayish-brown, carbonaceous in places, few siltstone lenses up to 2½ ft thick; 1-ft carbonaceous zone above base	20	0
215. Sandstone, medium-light-gray, very fine grained, silty, fossil plant fragments	1	6
216. Shale, medium-gray, thin and evenly bedded	2	6
217. Sandstone, medium-light-gray, pyrite nodules	5	0
218. Shale, medium-gray, thin and evenly bedded	3	0

	Thickness	
	Ft	in
219. Siltstone, medium-gray, thin and irregularly bedded	3	0
220. Shale, medium-gray to dark-gray, thin and evenly bedded, slightly carbonaceous	6	0
221. Sandstone, light-gray, fine-grained, thin-bedded	3	6
222. Shale, medium-gray to medium-dark-gray, thick-bedded, slightly bentonitic	10	0
223. Sandstone, medium-light-gray, fine-grained, thin-bedded, very calcareous, very friable, very silty, shale interbeds	32	0
224. Shale, medium-gray to medium-dark-gray, thin-bedded, coal zone 5 ft above base slightly bentonitic; 2-in-thick coal zone at top	10	6
225. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, very calcareous	20	0
226. Underclay, medium-gray, poorly bedded, fossil rootlets, silty, few coal fragments	4	6
227. Sandstone, medium-light-gray, thin-bedded, silty		8
228. Shale, medium-gray, thin-bedded, very silty, sandy	2	6
229. Sandstone, light-gray, fine-grained, thin-bedded, few carbonaceous laminations	5	6
230. Shale, medium-gray to light-grayish-brown to medium-dark-gray, coal fragments, locally slightly bentonitic	7	0
231. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, lens-shaped beds, shale in upper 2 ft	9	0
232. Shale, medium-gray, thin-bedded, silty, sandy, gypsum crystals, iron-stained, carbonaceous in top ½ in	4	0
233. Shale, light-grayish-brown, silty, sandy, very carbonaceous, coal fragments	1	2
234. Bentonite, light-brown to light-olive-gray with gypsum crystals, calcareous		6
235. Sandstone, medium-light-gray, very fine grained, pyrite nodules, upper 2 ft very silty	4	2
236. Shale, medium-gray to light-brownish-gray, thin and evenly bedded	4	6
237. Sandstone, light-gray, fine-grained, thick-bedded, silty, fossil roots	3	6
238. Shale, light-gray, in basal 8 in; upper part light brownish gray, volcanic ash bed contains crystallites	2	0
239. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, very calcareous, pyrite nodules, shale chips in basal 4 in, lens-shaped beds	20	0
240. Shale, medium-gray, thin and evenly bedded	4	0
241. Sandstone, medium-light-gray, thin-bedded, silty, lens-shaped, contains 6-in-thick shale lens 8 in below top	21	0
242. Shale, medium-gray, thin and evenly bedded	3	0
243. Shale, light-grayish-brown, very carbonaceous, contains 1-in-thick impure coal, lens-shaped beds in central part of unit		8
244. Shale, medium-gray, poorly bedded, very silty	4	0
245. Limestone, medium-gray, upper 2 ft contains 50 percent shale lenses	3	0
246. Sandstone, medium-light-gray to gray, very fine grained, grades massive- to thin-bedded upward, silty at top of unit	4	6
247. Shale, medium-gray to light-gray to light-brownish-gray, few carbonaceous beds with coal fragments	6	6
248. Sandstone, medium-light-gray, fine-grained, silty in basal 1 ft, contains siltstone coated with iron oxide, silty interbeds	4	0
249. Shale, medium-gray, thin and evenly bedded, contains 8-in-thick carbonaceous shale 4 ft above base	10	0
250. Underclay, medium-gray, nonbedded, fossil rootlets, upper 8 in very silty, carbonaceous	2	6
251. Coal, bright, fine to medium cleats		7
252. Shale, medium-gray, nonbedded	1	4
253. Sandstone, thin-bedded, fine-grained, silty, fossil roots at top	2	0
254. Coal, brownish-gray, bony		9
255. Shale, medium-gray, thin-bedded, bentonitic	3	6
256. Sandstone, medium-light-gray, thin-bedded, silty	2	6
257. Shale, medium-gray, slightly bentonitic, coal fragments at top	4	0
258. Sandstone, medium-light-gray, very fine grained, thin-bedded, crossbedded, very calcareous, pyrite nodules	4	6
259. Shale, medium-gray, thin-bedded, few carbonaceous plant fragments, siltstone and sandstone interbeds; 6-in-thick carbonaceous shale at base	20	6
260. Sandstone, medium-light-gray, thin- to massive-bedded, silty, upper 5 ft shaly and silty	10	0
261. Shale, medium-gray; 4-in-thick carbonaceous zone 2½ ft above base; becomes sandy at top	14	0
262. Sandstone, medium-light-gray, very fine to fine-grained, massive-bedded, silty, upper 4 ft very calcareous	25	0
263. Shale, medium-gray, nonbedded, bentonitic, volcanic ash fragments; 8-in-thick carbonaceous zone 5 ft above base; 1-ft-thick thin-bedded bony coal 10 ft above base; 2-ft-thick carbonaceous zone 20 ft above base	26	0
264. Siltstone, medium-gray, thin-bedded, very fine grained, top part sandy and shaly	2	0
265. Shale, medium-gray to light-grayish-brown, nonbedded, slightly carbonaceous	3	6

	Thickness	
	Ft	in
266. Shale, grayish-brown, very carbonaceous, silty	2	0
267. Shale, medium-gray, thin-bedded	3	0
268. Sandstone, light-gray, fine- to medium-grained, massive-bedded, silty at top of unit	4	0
269. Shale, medium-gray, thin and poorly bedded, upper 1 ft very silty	5	0
270. Underclay, medium-gray, fossil rootlets	1	6
271. Coal, brown		4
272. Shale, light-grayish-brown, carbonaceous		4
273. Sandstone, medium-light-gray, thin- to thick-bedded, silty, few shale interbeds	18	0
274. Underclay, medium-gray, fossil rootlets, very silty	1	0
275. Shale, light-grayish-brown, very carbonaceous, abundant fossil plant fragments	1	2
276. Shale, medium-gray, thin-bedded, slightly carbonaceous	4	10
277. Sandstone, medium-light-gray, silty, fossil plant impressions, contains few shale interbeds	5	0
278. Shale, medium-gray, thin-bedded, contains 1-ft-thick siltstone lens 6 in below top, well-preserved rootlets near top contact	5	0
279. Siltstone, medium-gray, thick-bedded	3	6
280. Shale, medium-gray, thin and evenly bedded	6	0
281. Sandstone, medium-light-gray, very fine grained, silty, shaly, very calcareous, fossil roots, ironstone 4 ft below top; 2-ft-thick shale interbeds near top	12	0
282. Shale, medium-gray, thin and evenly bedded	3	6
283. Limestone, medium-gray, hard, brittle	2	0
284. Sandstone, medium-light-gray, fine-grained, silty, pyrite nodules, very calcareous	1	3
285. Shale, silty, carbonaceous, abundant coal fragments	1	0
286. Shale, medium-gray, thin-bedded, silty	3	0
287. Sandstone, medium-light-gray, thin-bedded, silty, abundant coal fragments	4	6
288. Siltstone, medium-gray, fine-grained sandstone and shale interbeds; fossil roots at top	9	0
289. Shale, medium-gray, thin-bedded, silty	4	10
290. Shale, light-grayish-brown, thin-bedded, silty, very carbonaceous, few fossil roots, abundant fossil plant fragments	1	6
291. Coal, brown, resin blebs, fine cleats		6
292. Shale, light-grayish-brown, silty, very carbonaceous, coal fragments, few fossil rootlets	1	10
293. Underclay, medium-gray, nonbedded, silty, fossil rootlets	2	2
294. Shale, light-grayish-brown, thin-bedded, silty, very carbonaceous	1	6
295. Sandstone, medium-light-gray, thin-bedded, crossbedded, silty, pyrite nodules	4	6
296. Shale, light-grayish-brown, silty, very carbonaceous, coal fragments	3	0
297. Shale, medium-gray, bentonitic	2	6
298. Sandstone, medium-light-gray, very fine to fine-grained, massive-bedded, few calcareous solution cavities	27	0
299. Shale, medium-gray, thin and evenly bedded, silty	1	6
300. Shale, grayish-brown, thin-bedded, silty, abundant coal fragments, few fossil roots	1	8
301. Coal, resin, thin-banded, blebs, top channeled and filled by unit 302		7
302. Sandstone, light-gray, fine-grained, massive-bedded, crossbedded, silty, solution cavities, lens-shaped beds	4	6
303. Shale, medium-gray, thin and evenly bedded	1	0
304. Shale, light-grayish-brown, nonbedded, very carbonaceous, gypsum crystals	1	8
305. Shale, medium-gray, thin- to poorly bedded, basal 1 ft 2 in very sandy, includes 7-in-thick light-olive-gray bentonite lens	7	10
306. Sandstone, medium-light-gray, fine- to medium-grained, nonbedded, base fills channel in unit 305, top 1 ft calcareous	4	6
307. Shale, medium-gray, few carbonaceous zones	7	0
308. Shale, dark-grayish-brown, thin-bedded, silty, very carbonaceous, fossil plant fragments	2	0
309. Shale, medium-dark-gray, thin and evenly bedded	4	2
310. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	2	6
311. Shale, medium-gray, thin and evenly bedded; 6-in-thick light-grayish-brown zone 1 ft above base; 6-in-thick carbonaceous zone 6 ft above base; 2-ft-thick bentonitic zone 3 ft below top	11	0
312. Sandstone, medium-light-gray, silty, fossil roots	2	6
313. Shale, medium-gray, thin and evenly bedded	4	0
314. Siltstone, medium-gray, fine-grained, sandy	2	0
315. Shale, medium-dark-gray, thin and evenly bedded, carbonaceous	3	4
316. Sandstone, medium-light-gray, thin-bedded	1	6
317. Shale, medium-gray, thin and evenly bedded, very fine grained, sandy lenses	2	0
318. Siltstone, medium-gray, very fine grained sandstone and ironstone beds, shaly	4	0
319. Shale, medium-gray to light-gray, silty, poorly bedded; 1-ft-thick black, carbonaceous, sooty zone at the top	3	6
320. Sandstone, medium-light-gray, very fine to fine-grained, thin- to massive-		

		Thickness	
		Ft	in
	bedded, solution cavities, pyrite nodules, upper 8 in thin-bedded, very calcareous	3	8
321.	Shale, medium-gray, thin and evenly bedded, basal 1 ft very silty	8	0
322.	Siltstone, medium-gray, grades into sandstone	5	6
323.	Shale, medium-gray, thin and evenly bedded	4	0
324.	Sandstone, medium-light-gray, very fine grained, thin-bedded, calcareous	3	0
325.	Sandstone, light-gray, fine- to medium-grained, few siltstone beds, few shale chips, very friable	27	0
326.	Shale, medium-gray, thin-bedded, silty, sandy	1	6
327.	Sandstone, light-gray to medium-light-gray, very fine to fine-grained; 4-in-thick ironstone lens 16 ft above base	18	0
328.	Shale, medium-gray, thin-bedded	2	2
329.	Limestone, medium-gray, brittle, fractured, abundant iron stains; 1½-ft-thick very calcareous sandstone 1 ft below top	5	0
330.	Shale, medium-gray, thin and evenly bedded, sandy at top	5	0
331.	Siltstone, medium-gray, thin-bedded, shaly	2	6
332.	Shale, medium-gray, poorly bedded, silty, sandy	2	0
333.	Sandstone, light- to medium-gray, very silty	1	1
334.	Siltstone, medium-gray, poorly bedded	3	0
335.	Siltstone, medium-gray, poorly bedded, shaly	4	2
336.	Sandstone, medium-light-gray, silty, thin-bedded	4	0
337.	Siltstone, medium-gray, fine-grained, iron-stained, calcareous, abundant fossil roots	1	8
338.	Shale, medium-gray, poorly bedded, silty, sandy	1	10
339.	Sandstone, light-gray to medium-gray, fine-grained, massive-bedded, crossbedded	17	6
340.	Shale, medium-gray; 10-in-thick siltstone lens 1 ft 3 in above base	4	0
341.	Sandstone, light-gray to medium-gray, fine-grained, massive-bedded, crossbedded	1	9
342.	Shale, medium-gray, thin-bedded to nonbedded, becomes sandy upward	2	6
343.	Sandstone, light-gray to medium-gray, fine-grained, massive-bedded, crossbedded	1	0
344.	Shale, medium-gray, thick-bedded	1	10
345.	Sandstone, medium-light-gray, silty, ironstone band	2	6
346.	Shale, medium-gray, thin and evenly bedded, grades sandy upward	3	0
347.	Sandstone, light-gray, very fine grained, siltstone-shale interbeds, silty	6	0
348.	Sandstone, medium-light-gray, very fine grained, silty, calcareous, top very iron stained, abundant fossil plant impressions	4	0
349.	Shale, medium-gray to light-gray, poorly bedded, silty, slightly bentonitic	9	0
	Total measured thickness of main body of Mesaverde Formation	2,060	2½
White sandstone member:			
350.	Sandstone, light-gray, fine-grained, thick-bedded to massive, pyrite nodules, fractures filled with quartz, crossbedded	22	0
351.	Siltstone and very fine grained sandstone, medium-gray, nonbedded, grades into sandstone upward	5	0
352.	Sandstone, medium-light-gray, massive-bedded, silty	3	6
353.	Shale, very silty, sandy, lens-shaped beds	5	0
354.	Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, crossbedded	7	0
355.	Shale, medium-gray to medium-light-gray	5	6
356.	Siltstone, medium-gray, fine-grained, thin-bedded, sandy in basal 1 ft	5	0
357.	Shale, medium-gray, poorly bedded, very silty, sandy interbeds	5	0
358.	Sandstone, light-gray, very fine to fine-grained, crossbedded, dark and light mineral grains, pyrite nodules	35	0
359.	Shale, medium-gray, poorly bedded, slightly bentonitic	9	6
360.	Sandstone, light-gray, basal 15 ft thin-bedded, crossbedded, solution cavities, pyrite nodules; 1-ft-thick silty-shaly interbeds with iron stains, carbonaceous zones, abundant iron stains	80	0
361.	Sandstones, light-grayish-brown, fine-grained, shaly, silty, very carbonaceous	3	6
362.	Shale, light-grayish-brown, thin-bedded, silty, sandy, carbonaceous, abundant fossil plant material, iron stains	20	6
	Total measured thickness of white sandstone member of Mesaverde Formation	206	6
	Total measured thickness of Mesaverde Formation	2,266	8½
Meeteetse Formation:			
363.	Shale, dark-grayish-brown, thin-bedded, bony, coal band		8
364.	Shale, light-grayish-brown, poorly bedded, very sandy, silty	4	4
365.	Sandstone, light-gray, fine- to medium-grained, thin-bedded to massive, crossbedded, upper 5 ft calcareous and thin-bedded	15	0
366.	Sandstone, light-brownish-gray, very fine grained, carbonaceous, very silty, abundant fossil plant material; 6-in-thick shale 2 ft below top; top 2 ft ironstone, very iron stained	13	0

	Thickness	
	Ft	in
367. Shale, medium-gray to medium-light-gray, irregularly bedded to nonbedded, sandy, silty, few fossil roots	5	0
368. Underclay, medium-grayish-brown, sandy, silty, abundant fossil plants and roots	1	0
369. Shale, dark-grayish-brown to black, thin-bedded, silty, very carbonaceous, scattered coal chips and lenses, sulphur-stained	1	2
370. Sandstone, very light gray, very fine grained, thin and irregularly bedded, silty, fractures filled with gypsum	2	0
371. Shale, medium-brownish-gray, poorly bedded, fossil plant fragments, carbonaceous		9
372. Sandstone, very light gray, very fine grained, thin and irregularly bedded, silty	1	7
373. Shale, medium-grayish-brown, few black carbonaceous lenses up to 1 in thick, silty, scattered fossil plant fragments	11	0
374. Sandstone, light-gray, very fine grained, thin- to thick-bedded	1	11
375. Shale, dark-grayish-brown to black, very carbonaceous, scattered fossil plant fragments, contains coalified log, bright	1	0
376. Shale, medium-gray, thin- to poorly bedded; 6-in-thick very fine grained sandstone lens 6½ ft above base	12	0
377. Shale, dark-grayish-brown to black, abundant fossil plant fragments, carbonaceous coal fragments, sulphur-stained	1	6
378. Shale, medium-gray, thin and evenly bedded, carbonaceous in top 3 in	2	0
379. Bentonite, light-olive-gray to light-yellowish-gray, poorly bedded to nonbedded	1	2
380. Shale, light-brownish-gray, thin-bedded, slightly carbonaceous, few silty lenses up to 2 in thick	5	6
381. Sandstone, very light gray, very silty, very shaly, fossil plant fragments	5	0
382. Underclay, medium-brownish-gray, coal fragments, very silty, fossil root and plant fragments	1	3
383. Coal, very dull, few bright lenses, bony, very impure, shale lenses		9
384. Shale, medium-brownish-gray, carbonaceous, thin-bedded	1	1
385. Underclay, medium-gray, thin and irregularly bedded, very sandy and silty, fossil root fragments		8
386. Shale, medium-gray, thin-bedded		10
387. Sandstone, light-gray, very fine grained, crossbedded, thin- to thick-bedded, silty, iron stains	2	8
388. Shale, medium-gray, thin-bedded, slightly bentonitic; 4-in-thick bentonitic zone 7 ft above base; carbonaceous in top 6 in, weathered	23	6
389. Sandstone, light gray, very fine grained, thin- to thick-bedded, very silty, pyrite nodules	5	4
390. Shale, medium-gray to medium-dark-gray, thin-bedded, slightly carbonaceous	4	10
391. Coal, dull, impure, very bony, scattered shale partings		11
392. Sandstone, light-gray, very fine grained, thin- to thick-bedded, very silty, plant fossils in basal 2 in, pyrite nodules	3	0
393. Underclay, light-brownish-gray, thin- to poorly bedded, abundant fossil plant and root fragments		6
394. Siltstone, light-gray, sandy, few root and plant fossils		7
395. Underclay, medium-brownish-gray, thin-bedded, fissile, carbonaceous, slightly silty, scattered coal fragments, gypsum crystals, fossil root and plant fragments		10
396. Shale, dark-gray to black, thin-bedded, carbonaceous, coaly, scattered coal and fossil plant fragments		4
397. Siltstone, light-gray, thin and irregularly bedded, sandy, 20 percent light-gray shale interbeds	6	11
398. Sandstone, light-gray, thin-bedded, very silty, highly iron stained in top 2 ft	7	0
399. Shale, medium-gray, 10 percent silt lenses up to 2 in thick	9	0
400. Underclay, light-brownish-gray, silty, hard, carbonaceous in top 4 in with scattered coal fragments, fossil roots, abundant fossil plant fragments	1	10
Base of unnamed coal bed		
401. Coal, bright to dull, slightly impure		10
402. Coal, bony, impure, bright laminations		8
403. Shale, medium-brownish-gray, carbonaceous		1
404. Coal, bright to dull, fine cleats, sulphur-stained	1	8
Top of unnamed coal bed		
405. Underclay, medium-gray, silty, fossil plant and root fragments		6
406. Shale, dark-gray to black, very carbonaceous, scattered coal laminations		6
407. Underclay, medium-gray, abundant mica, carbonaceous in upper 4 in, fossil plant fragments	1	4
408. Sandstone, medium-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, solution cavities, few interbeds of siltstone, pyrite nodules, lower 4 ft contains 20 percent fine carbonaceous laminations, capped by 2-in iron-stained, resistant siltstone	19	6
409. Shale, medium-gray, thin and evenly bedded		6
410. Shale, medium-brownish-gray, carbonaceous, abundant fossil plant fragments		3

	Thickness	
	Ft	in
411. Shale, dark-brownish-gray, carbonaceous, coaly laminations		4
412. Sandstone, light-gray to medium-gray, thin to thick and irregularly bedded, crossbedded, light and dark mineral grains, well-sorted, pyrite nodules, interbeds of shale and siltstone	18	0
413. Shale, medium-gray, thin and evenly bedded, sandy, thin interbeds of friable sandstone	11	4
414. Sandstone, light- to medium-gray, very fine to fine-grained, friable	1	4
415. Shale, medium-gray, thin and evenly bedded, thin sandstone interbeds, 10 percent carbonaceous beds in upper third of unit	16	0
416. Shale, medium-gray, thin and irregularly bedded, 30 percent siltstone interbeds	9	4
417. Sandstone, medium-gray, very calcareous, lower 3 ft is thin and evenly bedded, silty, upper 10 in is friable and nonresistant	5	0
418. Shale, medium-gray, thin and evenly bedded, siltstone 3 in thick at base	4	10
419. Sandstone, light- to medium-gray, fine-grained, crossbedded, silty, friable	2	10
420. Shale, medium-brown to gray, carbonaceous, thin and irregularly bedded, bentonitic	5	4
421. Shale, medium-gray, thin and evenly bedded	4	10
422. Shale, medium-brownish-gray, carbonaceous, thin and evenly bedded, bentonitic in upper half of unit	10	4
423. Siltstone, medium-gray, thin and irregularly bedded, very calcareous, iron-stained, resistant	1	5
424. Shale, medium-gray, thin and evenly bedded		10
425. Shale, medium-brownish-gray, carbonaceous	1	0
426. Sandstone, medium-gray, fine- to medium-grained, very carbonaceous, abundant fossil plant fragments, friable	6	0
427. Shale, medium-gray, thin and evenly bedded	4	8
428. Shale, dark-brownish-gray, carbonaceous, upper half of unit very bentonitic, abundant fossil plant fragments	1	6
429. Shale, medium-gray, thin and evenly bedded, sandy	2	6
430. Shale, medium-brownish-gray, carbonaceous, interbeds of gray shale, abundant fossil plant fragments	9	8
431. Sandstone, medium-gray, fine-grained, friable, silty, shale interbeds, light and dark mineral grains, deeply weathered	40	6
432. Sandstone, light- to medium gray, medium-grained, highly iron stained	1	2
433. Sandstone, light- to medium-gray, fine- to medium-grained, friable	16	0
434. Shale, medium-gray, thin and evenly bedded, bentonitic	8	0
435. Sandstone, light-medium-gray, fine- to medium-grained, friable	6	8
436. Shale, medium-gray, thin and evenly bedded, basal 10 in carbonaceous	14	4
437. Sandstone, medium-gray, fine- to medium-grained, fossil plant fragments	1	2
438. Shale, medium-gray, thin and evenly bedded, carbonaceous, sandy, bentonitic in upper few inches	1	0
439. Sandstone, medium-gray, very fine grained, highly carbonaceous	1	10
440. Sandstone, medium-gray, very fine to fine-grained, very carbonaceous, friable, deeply weathered	5	0
441. Shale, medium-dark-brownish-gray, carbonaceous, friable, sandy, basal 6 in contains coal fragments; 1-ft-10-in-thick sandstone interbeds 6 in above base	6	2
442. Shale, dark-brownish-gray, carbonaceous, coaly laminations, basal 8 in resistant	1	4
443. Bentonite, medium-olive-gray	6	2
444. Shale, dark-brownish-gray, carbonaceous		6
445. Bentonite, medium-olive-gray, abundant fossil plant material		2½
Base of Welton coal bed		
446. Coal, dull, few bright bands, impure, fine to medium cleats, shale laminations		8
447. Shale, dark-brownish-gray, carbonaceous, abundant coaly fragments		6
448. Sandstone, medium-gray, very fine to fine-grained	4	8
449. Underclay, very sandy, abundant fossil plant and root fragments		10
450. Shale, very dark brownish gray, carbonaceous		4
451. Coal, very impure, dull, few bright bands, shale laminations, gypsum crystals, resin blebs, fine to medium cleats, upper 5 in mostly bright	1	8
452. Shale, medium-gray, thin and evenly bedded	1	2
453. Underclay, medium-dark-brownish-gray, abundance of fossil plant fragments, coal laminations		3
454. Coal, bright and dull bands, shale, very impure, resin blebs, upper 3 in mostly bright		10
Top of Welton coal bed		
455. Bentonite, medium-olive-gray	1	4
456. Shale, very dark brownish gray, thin and evenly bedded, carbonaceous	1	8
457. Shale, very dark brownish gray, thin and evenly bedded, carbonaceous	1	10
458. Shale, basal 1½ ft dark-brownish-gray, nonbedded	3	0
459. Underclay, medium-olive-gray, contains fossil plant fragments	1	6
460. Shale, medium-dark-brownish-gray, thin and irregularly bedded, very bentonitic		6

	Thickness	
	Ft	in
461. Bentonite, medium-olive-gray		10
462. Shale, dark-brownish-gray, carbonaceous, abundant fossil plant fragments	1	6
463. Shale, olive-gray, sandy, bentonitic		8
464. Shale, dark-brownish-gray, carbonaceous, thin and irregularly bedded	2	6
465. Shale, thin and evenly bedded, carbonaceous in upper 2 ft	3	2
466. Shale, medium-gray, thin and evenly bedded	10	6
467. Sandstone, medium-gray, very fine grained, thin- to thick-bedded, iron-stained, very calcareous, resistant, pyrite nodules, basal 2 ft contains fossil roots up to 14 in long; top 6 in carbonaceous	9	10
468. Shale, thin and evenly bedded, dark-brownish-gray in basal 2 in, next 1½ in very dark gray to black, top 3 in medium-brownish-gray; carbonaceous, scattered gypsum crystals		9
469. Sandstone, friable, bentonitic in base, carbonaceous zone above, highly weathered	5	0
470. Underclay, sandy, abundant fossil plant and root fragments	1	2
471. Shale, carbonaceous, coal fragments		3½
472. Bentonite, medium-dark-olive-gray, sandy	12	0
473. Shale, medium- to dark-brownish-gray, carbonaceous	4	6
474. Shale, very dark gray to black, thin-bedded, carbonaceous	1	4
475. Shale, light-olive-gray, thin- to poorly bedded, silty, few scattered fossil plant fragments	7	0
476. Sandstone, light-gray, very fine grained, silty	2	0
477. Underclay, medium-gray, gypsum crystals, carbonaceous in top 1 in, fossil roots	2	2
478. Sandstone, light-gray, very fine grained, silty	2	0
479. Underclay, light-olive-gray, sandy, bentonitic, fossil roots	1	10
480. Shale, dark-brownish-gray, thin-bedded, carbonaceous, few scattered coal fragments	1	3
481. Sandstone, very fine to fine-grained, friable, silty, plant fossils	7	0
482. Shale, light-olive-gray to light-gray, thin and evenly bedded, silty, few scattered siltstone laminations	5	6
483. Sandstone, very light gray, very fine grained, thin and irregularly bedded, very silty	5	0
484. Shale, medium-light-gray, thin and evenly bedded, scattered fossil plants	1	6
485. Sandstone, very light gray, thin and irregularly bedded, very calcareous, very silty	12	0
486. Shale, medium-brownish-gray, sandy, carbonaceous	3	0
487. Sandstone, light-gray, very fine to fine-grained, silty, abundant dark and light mineral grains, scattered ironstone lenses up to 1 in thick, friable; 1-ft-thick siltstone lens 13 ft above base	15	0
488. Shale, light- to medium-gray, thin and evenly bedded	5	0
489. Sandstone, light-gray, fine-grained, thick-bedded to massive, slightly silty, dark and light mineral grains, crossbedded, lens-shaped beds	7	0
490. Shale, medium-gray, thin- to poorly bedded, very silty	7	2
491. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, locally crossbedded, very silty	8	6
492. Shale, medium-gray, thin and evenly bedded	1	3
493. Shale, light-olive-gray to light-gray, nonbedded, hard, silty	1	8
494. Shale, light-olive-gray, thin and evenly bedded	5	0
495. Sandstone, light-gray, very fine grained, ripple beds, very silty, calcareous	11	0
496. Shale, medium-gray, thin and evenly bedded	8	6
497. Shale, medium-brownish-gray, thin-bedded, carbonaceous, gypsum crystals	1	2
498. Shale, light-olive-gray, silty, scattered siltstone lenses up to ½ in thick	4	0
499. Sandstone, very light gray, very fine grained, thick-bedded to massive in lower half of unit, thin- to thick-bedded in upper half, silty, micaceous	6	0
500. Shale, medium-gray, thin- and to poorly bedded, silty, scattered fossil plant fragments	4	6
501. Shale, light-yellowish-gray, thin-bedded, silty, abundance of gypsum		6
Total measured thickness of Meeteetse Formation	621	8
Unconformity		
Lance Formation:		
502. Sandstone, very light gray, very fine to fine-grained, thick-bedded to massive, pyrite nodules, few shale chips in basal 3 ft, solution cavities, micaceous, dark and light mineral grains	159	0
503. Shale, medium-gray, thin and evenly bedded, silty, slightly carbonaceous in basal 1 ft, abundant scattered petrified wood on surface	6	6
504. Sandstone, very light gray, fine-grained, thick-bedded to massive, crossbeds, abundance of dark and light mineral grains, scattered shale lenses up to 1 ft thick, calcareous, few solution cavities, iron stained in top 3 ft	58	0
505. Shale, medium-gray, thin and evenly bedded	7	6
506. Sandstone, medium-light-gray, very fine grained, silty, abundant dark and light mineral grains, very calcareous, very iron stained	7	0

	Thickness	
	Ft	in
507. Shale, medium-gray, thin and irregularly bedded, weathered	5	0
508. Sandstone, very light gray, very fine grained, thick-bedded to massive, noncalcareous, slight petroleum stain, base sharp and undulatory	11	6
509. Shale, medium-gray, thin and evenly bedded	1	6
510. Siltstone, medium-gray, very iron stained, sandy	1	0
511. Shale, medium-gray, weathered	6	0
512. Sandstone, light-gray, very fine grained, thin-bedded, scattered carbonaceous matter, weathered	3	0
513. Underclay, medium-light-gray, nonbedded, very silty, fossil rootlets, pyrite nodules	10	0
514. Sandstone, very light gray, very fine grained, solution cavities, resistant	7	0
515. Shale, medium-gray, nonbedded	6	6
516. Sandstone, very fine to fine-grained, thin- to thick-bedded, silty, dark and light mineral grains, pyrite nodules, base sharp and undulatory, few fossil roots at top	38	0
517. Shale, medium-gray, thin and irregularly bedded, bentonitic in upper 1 ft	10	0
518. Sandstone, very light gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, silty, noncalcareous, pyrite nodules, weathered	11	0
519. Shale, medium-gray, thin and evenly bedded, scattered fossil plant fragments	2	4
520. Sandstone, light-gray, very fine grained, silty, nonresistant	12	0
521. Shale, medium-gray, thin and evenly bedded	6	6
522. Sandstone, light-gray, very fine grained, silty, thick and irregularly bedded, very calcareous, iron-stained	2	8
523. Shale, medium-gray, thin and evenly bedded	2	0
524. Sandstone, very light gray, very fine grained, very silty, micaceous, few dark and light mineral grains	6	0
525. Shale, medium-gray, thin and evenly bedded	1	6
526. Bentonite, light-olive-gray	1	0
527. Shale, medium-gray, thin and evenly bedded, bentonitic, 1-ft-thick shale lens 20 ft above base; carbonaceous in top foot	26	0
528. Sandstone, very light gray, very fine grained, thick-bedded, silty	1	6
529. Shale, medium-gray, thin and evenly bedded; 8-in-thick very fine grained, silty, sandstone lens 8 ft above base	12	0
530. Sandstone, light-gray, very fine grained, thin to thick and irregularly bedded, silty, pyrite nodules	5	6
531. Bentonite, light-olive-gray	2	8
532. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, thin and irregularly bedded above 3 ft, dark and light mineral grains; 2-ft-thick medium-gray shale lens 15 ft above base	45	0
533. Shale, medium-gray, thin and evenly bedded, carbonaceous in upper half of unit	15	0
534. Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, pyrite nodules in lower 3 ft; from 3 ft to 8 ft fine- to medium-grained with shale chips; above 8 ft medium-grained, crossbedded, abundant shale chips, fossils, pyrite nodules, solution cavities, noncalcareous	50	0
535. Shale, light-gray to light-olive-gray, bentonitic	5	0
536. Sandstone, light-gray, very fine grained, silty, thick-bedded, iron-stained	6	6
537. Shale, light-gray to olive-gray, thin-bedded to nonbedded	25	0
538. Sandstone, mostly very fine-grained, some medium-grained, thin-bedded to nonbedded, very silty, calcareous, lens-shaped bed, fossil roots	1	0
539. Shale, light-gray to light-olive-gray, bentonitic, thin and irregularly bedded	28	0
540. Sandstone, light-gray, very fine grained, silty		10
541. Shale, light-gray to light-olive-gray, bentonitic		7
542. Sandstone, light-gray, very fine grained, thin- to thick-bedded, very silty, scattered shale lenses	2	8
543. Shale, light-gray to light-olive-gray, thin and evenly bedded	1	6
544. Sandstone, light-gray, very fine grained, thick-bedded, very silty, noncalcareous	1	1
545. Shale, light-gray to light-olive-gray, thin and evenly bedded, bentonitic	16	0
546. Sandstone, very fine to fine-grained, thin to thick and irregularly bedded, dark and light mineral grains, silty, scattered carbonaceous matter, noncalcareous	15	0
547. Bentonitic, light-olive-gray	15	0
548. Sandstone, very fine to fine-grained, thick- to massive-bedded, silty, dark and light mineral grains, abundant dark minerals, very silty at top	5	6
549. Bentonite, light-olive-gray, thin and evenly bedded, gypsum crystals	8	4
550. Underclay, medium-gray to medium-grayish-brown, carbonaceous, fibrous gypsum, abundant fossil roots		4
551. Coal, bright, fine cleats, interbedded gypsum crystals and sulfur stain		4
552. Underclay, medium-gray to medium-brownish-gray, gypsum crystals, silty, abundant fossil root and plant prints	1	6
553. Shale, light-olive-gray, thin and irregularly bedded, bentonitic	2	10
554. Sandstone, light-gray, very fine grained, thin to thick and irregularly bedded,		

		Thickness	
		Ft	in
	very silty, scattered fossil plant fragments	9	0
555.	Shale, light-olive-gray, gypsum, crystals	3	6
556.	Sandstone, very light gray, very fine grained, very silty, thin and irregularly bedded, crossbedded, scattered carbonaceous matter	17	0
557.	Shale, light-olive-gray, bentonitic, carbonaceous in top 1 ft	7	0
558.	Sandstone, very fine grained, silty, dark and light mineral grains	8	0
559.	Bentonite, medium-olive-gray, shaly	29	0
560.	Sandstone, very fine grained, thin- to thick-bedded, crossbedded, silty, gypsum-filled fractures	12	0
	Total measured thickness of Lance Formation	762	8

Unconformity

Paleocene:

Fort Union Formation, Shotgun Member:

		Thickness	
		Ft	in
561.	Shale, medium-gray to light-olive-gray, interbedded with variegated grayish-red and olive-green, nonbedded to poorly bedded, abundant gypsum crystals, scattered siltstone and sandstone lenses up to 1 ft thick, strike 60°, dip 10° SE.	108	0
562.	Sandstone, light-gray, very fine grained, thin to thick and irregularly bedded, very silty, pyrite nodules, carbonaceous at 1 ft 7 in from base, scattered solution cavities, slightly carbonaceous at top	7	0
563.	Shale, light-gray to light-olive-gray, slight grayish-red mottling, bentonitic	5	0
564.	Sandstone, light-gray, very fine grained, thin to thick and irregularly bedded, very silty, slightly iron stained	4	6
565.	Shale, light-gray to light-olive-gray, bentonitic, three sandstone interbeds about 10 in thick, top 1 ft light-blue-gray and sandy	25	0
566.	Sandstone, light-gray, very fine grained, thin to thick and irregularly bedded, very silty, slightly iron stained	3	0
567.	Shale, light-gray to light-olive-gray, bentonitic, thin and irregularly bedded, gypsum crystals; 6-in-thick carbonaceous shale lens 6 ft below top	31	0
568.	Sandstone, light-gray, very fine grained, very silty	5	0
569.	Shale, light-gray to light-olive-gray, bentonitic	5	6
570.	Sandstone, light-gray, very fine grained, very silty	7	0
571.	Underclay, medium-grayish-brown, silty, gypsum crystals, abundant fossil plant fragments		4
572.	Shale, medium-grayish-brown, carbonaceous fossil plant fragments, silty, gypsum crystals, scattered bright coal fragments		5
573.	Shale, light-gray to light-olive-gray, thin and irregularly bedded, scattered fossil plant fragments	5	0
574.	Sandstone, light-gray, very fine grained, thick- to massive-bedded, very silty	15	0
575.	Shale, light-gray to light-olive-gray, silty, bentonitic, carbonaceous in upper 6 in	8	6
576.	Sandstone, light-gray, very fine grained, thick- to massive-bedded, very silty		8
577.	Shale, light-gray to light-olive-gray, gypsum crystals	8	0
578.	Sandstone, light-gray, very fine grained, silty	2	6
579.	Shale, medium-gray	3	0
580.	Siltstone, light-gray, sandy	1	2
581.	Shale, medium-gray to light-gray, silty	4	0
582.	Sandstone, light-gray, very fine grained carbonaceous siltstone lenses, very silty, ironstone nodules, iron-stained in top 2 ft	11	0
583.	Shale, light-olive-gray, thin-bedded	3	11
584.	Ironstone band, dark-brown to black		8
585.	Siltstone, light-olive-gray, thin-bedded to nonbedded, silty, sandy	3	5
586.	Sandstone, light-gray, very fine grained, thin- to thick-bedded, very silty, basal 6 ft burrowed	2	0
587.	Sandstone, light-gray, very fine grained, very silty, massive-bedded in upper 10 in, iron-stained, lenticular	4	0
588.	Shale, light-gray to light-olive-gray, very bentonitic, carbonaceous shale in top 1 ft	7	6
589.	Sandstone, light-gray, very fine-grained, thin- to thick-bedded, very silty, iron-stained in upper 1 ft	7	0
590.	Shale, light-gray to light-olive-gray, bentonitic, scattered gypsum crystals, scattered sand lenses up to 6 in thick	10	0
591.	Sandstone, light-gray, very fine grained, thin- to thick-bedded, very silty, resistant bench, iron-stained	1	6
592.	Shale, light-gray to light-olive-gray, bentonitic	23	0
593.	Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, iron-stained in top 6 ft	48	0
594.	Shale, light-gray to light-olive-gray, abundant bentonite, fibrous gypsum bands	4	0
595.	Sandstone, light-gray, very fine grained, crossbedded, very silty	8	6
596.	Shale, light-olive-gray, silty, bentonitic, gypsum crystals	3	0
597.	Sandstone, light-gray, very fine grained, very silty	4	6
598.	Siltstone, light-olive-gray; 6-in-thick sandstone lens 5 ft above base; top grades sandy	8	6
599.	Sandstone, light-gray, very fine grained, very silty, iron-stained at top	1	6

		Thickness	
		Ft	in
600.	Shale, light-olive-gray, thin and irregularly bedded with sandstone and siltstone laminations up to 8 in thick	5	0
601.	Sandstone, very fine grained, thin-bedded, silty, iron-stained at top	5	0
602.	Shale, light-gray to light-olive-gray, bentonitic	20	0
603.	Sandstone, light-gray to light-olive-gray, very fine grained, thin- to thick-bedded, dark gray shale laminations up to 1 in thick, weathered	18	0
604.	Shale, light-gray to light-olive-gray, nonbedded	9	0
605.	Sandstone, very fine grained, silty, iron-stained, resistant	1	2
606.	Bentonite, light-olive-gray	11	0
607.	Shale, light-olive-gray to light-brownish-gray, carbonaceous, abundant gypsum lenses up to 1 in thick	1	4
608.	Sandstone, light-gray, very fine grained, very silty, weathered	11	0
609.	Shale, light-olive-gray, thin and irregularly bedded	5	0
610.	Siltstone, medium-gray, thin- to thick-bedded, very calcareous, resistant, iron-stained, top grades into shale	1	8
611.	Shale, medium-gray		6
612.	Siltstone, light-olive-gray, nonbedded	3	6
613.	Shale, light-olive-gray, thin and irregularly bedded	1	0
614.	Siltstone, very iron stained	1	0
615.	Shale, light-olive-gray, nonbedded, gypsum crystals	6	6
616.	Sandstone, light-gray, very fine grained, very silty, gypsum crystals, resistant, basal 2 ft thin-bedded, carbonaceous, scattered coal chips and fragments up to 1 inch in diameter; sandstone laminations 1 ft thick in middle part of unit	13	0
617.	Shale, light-olive-gray, thin and evenly bedded, sandy	5	6
618.	Sandstone, light-olive-gray, very fine grained, very silty, wedges out laterally along outcrop	18	6
619.	Shale, light-olive-gray, nonbedded, silty	9	6
620.	Sandstone, light-gray to light-olive-gray, very fine grained, very silty, scattered resistant sandstone beds up to 8 in thick	49	0
621.	Shale, light-olive-gray, nonbedded, silty	12	0
622.	Shale, light-olive-gray, nonbedded, silty, weathers orange-gray	20	0
623.	Shale, light-olive-gray, bedded to nonbedded	9	0
624.	Sandstone, light-gray, very fine grained, very silty	10	0
625.	Siltstone, light-olive-gray, nonbedded	15	0
626.	Underclay, light-grayish-brown, silty, poorly bedded to nonbedded, scattered coal fragments, carbonaceous, fossil plant fragments	4	6
627.	Shale, light-olive-gray, nonbedded, silty	6	0
628.	Siltstone, resistant, iron-stained, calcareous, sandy		8
629.	Shale, light-olive-gray, thin and evenly bedded	5	0
630.	Sandstone, light-olive-gray, very fine grained, silty, resistant ledges up to 8 in thick; 2-ft-thick shale lens 10 ft above base	45	0
631.	Underclay, light-olive-gray to medium-brownish-gray, carbonaceous, gypsum crystals, silty and sandy, few coal fragments, abundant fossil plant and root fragments	3	2
632.	Sandstone, very fine grained, very silty, carbonaceous material, abundant fossil leaf impressions	1	2
633.	Siltstone, medium-light-gray, thin-bedded to nonbedded, sandy, scattered, iron-stained, resistant ledges	45	0
634.	Shale, light-olive-gray, thin and irregularly bedded, bentonitic	6	6
635.	Shale, light-olive-gray, nonbedded, silty	20	0
636.	Shale, light-olive-gray, grayish-red mottling, sandy, silty	10	0
	Total measured thickness of Fort Union Formation, Shotgun Member	810	9

Unconformity

Lower Eocene:

Indian Meadows Formation:

Conglomeratic member

		Ft	in
637.	Conglomerate, olive-gray to grayish-red, angular to subround, fragments and boulders up to 2 ft in diameter, abundant quartz pebbles, feldspar, epidote granitic material	30+	

Measured section 14: Cody Shale and Mesaverde Formation

Location: Hudson Quadrangle, Wyoming (7.5 min)
Start: SW–SW–NE sec. 3, T. 2 S., R. 2 E. Presented from oldest to youngest
End: SE–NW–NE sec. 3, T. 2 S., R. 2 E.
Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.
Strike 120°, Dip 15° NE.

		Thickness	
Upper Cretaceous:			
Cody Shale:		Ft	in
1.	Shale, medium-gray, silty	22+	
2.	Sandstone, medium-gray, very fine grained, thin-bedded		4
3.	Shale, medium-gray, silty	5	8
4.	Sandstone, medium-gray, very fine grained, thin-bedded		6
5.	Shale, medium-gray, silty	62	4
6.	Sandstone, medium-gray, very fine grained, thin-bedded		4
7.	Shale, medium-gray, silty	8	8
8.	Sandstone, medium-gray, very fine grained, thin-bedded		8

	Thickness	
	Ft	in
9. Shale, medium-dark-gray, slightly carbonaceous, few fossil rootlets	11	4
Total measured thickness of Cody Shale	111	10
Mesaverde Formation:		
10. Sandstone, medium-light-gray, very fine grained, thick-bedded to massive, silty, iron-stained at top	20	6
11. Siltstone, very light gray, 8-in-thick sandstone lens in medial part; scattered carbonaceous shale fragments and fossil plant fragments	3	0
12. Sandstone, very light gray, scattered dark and light mineral grains, massive, pyrite nodules, silty, carbonaceous shale lenses; fossil tree trunk casts 1 ft below top	11	6
13. Siltstone, medium-gray, shaly	1	0
14. Sandstone, very light gray, very fine grained, dark and light mineral grains, calcareous concretions	4	0
15. Siltstone, light-gray, very shaly, sandy, thin and irregularly bedded	7	0
16. Sandstone, medium-light-gray, very fine grained, thick-bedded, abundant dark and light mineral grains; 2-in-thick shale lens 1 ft above base	7	11
17. Siltstone, light-gray, sandy, poorly cemented, carbonaceous shale interbeds	6	4
18. Sandstone, medium-light-gray, very fine grained, thick-bedded to massive, friable, silty, calcareous; 6-in-thick shale and siltstone laminations 4½ ft above base; top part is fine to medium grained, calcareous	69	0
19. Sandstone, medium-light-gray, very fine grained, calcareous, thick-bedded, pyrite nodules	13	0
20. Shale, light-brownish-gray, thin and evenly bedded, silty, few siltstone lenses up to 1 in thick, very carbonaceous in top 2 in	2	0
21. Sandstone, medium-light-gray, very fine grained, thin-bedded, silty	3	0
22. Shale, medium-light-gray, thick-bedded, carbonaceous, very fine grained sandstone lenses, basal 1½ ft silty and sandy	3	8
23. Sandstone, medium-light-gray, thick-bedded, silty	4	0
24. Shale, medium-dark-gray, very fine grained, sandstone interbeds	10+	—
Total measured thickness of Mesaverde Formation	165	11

Unconformity

Lower Eocene:

Unconformably overlain by the conglomeratic member of the Indian Meadows Formation

Measured section 15: Cody Shale through Indian Meadows Formation

Location: Hudson Quadrangle, Wyoming (7.5 min)
Start: SW–SW–SW sec. 35, T. 1 S., R. 2 E. Presented from oldest to youngest
End: SW–SE–SE sec. 35, T. 1 S., R. 2 E.
Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.
Strike 120°, Dip 14° NE.

	Thickness	
Upper Cretaceous:		
Cody Shale:	Ft	in
1. Sandstone, light-gray, dark and light mineral grains, thick-bedded to massive, thin-bedded in top 6 in	6	0
2. Shale, medium-gray, thin and unevenly bedded, silty, sandy	8	0
3. Sandstone, light-gray, very fine grained, silty, weathered	30	0
4. Siltstone, medium-light-gray, thin- to poorly bedded, sandy	11	0
5. Sandstone, medium-light-gray, very fine grained, abundant siltstone laminations, few fossil plants, silty	32	6
6. Shale, light-gray, few dark and light mineral grains, thin and evenly bedded, silty	18	0
7. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains	4	0
8. Covered, probably sandy shale	110	0
9. Shale, medium-dark-gray, very sandy	5	0
10. Covered, probably sandy shale	10	0
Total measured thickness of Cody Shale	234	6
Mesaverde Formation:		
11. Sandstone, medium-light-gray, very fine to fine grained, dark and light mineral grains, thick-bedded to massive, crossbedded	42	0
12. Shale, medium-gray, thin-bedded, sandy, silty, abundant fossil plants	7	0
13. Sandstone, medium-light-gray, thin-bedded, silty	10	0
14. Sandstone, medium-light-gray, very fine to fine grained, thick-bedded to massive, pyrite nodules, iron-stained	65	0
15. Sandstone, very light gray to white, fine-grained, dark and light mineral grains, massive, crossbedded, pyrite nodules up to 7 inches in diameter, solution cavities, carbonaceous shale lense 4 ft below top	55	0
16. Underclay, medium-dark-gray, fossil rootlets, fossil plants	5	0
Base of Maverick Spring coal zone		
Base of A coal bed		
17. Coal, impure, bright to dull, fine to medium cleats, scattered resin blebs		10
18. Shale, medium-gray, thin-bedded, slightly carbonaceous	1	0
19. Sandstone, light-gray, very fine grained, dark and light mineral grains, grades very carbonaceous in top part of unit	2	0
20. Coal, bright to dull, mostly dull, fine to medium cleats, gypsum crystals, sulfur stain, resin blebs	1	6
Top of A coal bed		

	Thickness	
	Ft	in
21. Shale, light-brownish-gray to medium-gray, very carbonaceous, scattered coal laminations, resin blebs and gypsum crystals, abundant fossil plant fragments, top 1½ ft contains fine-grained sandstone lenses	2	10
22. Sandstone, medium-light-gray to light-gray, very fine grained, dark and light mineral grains, massive, carbonaceous laminations, silty	12	0
23. Shale, medium-dark-gray, carbonaceous, fossil plant fragments, sulfur-stain, gypsum crystals	2	0
24. Shale, medium-gray, thin and evenly bedded, very silty, pyrite nodules at top	12	4
25. Sandstone, medium-light-gray, very fine to fine-grained, massive, upper 2 ft thin- to thick-bedded; very calcareous, solution cavities	10	6
26. Sandstone, medium-light-gray, very fine grained, massive, friable, silty, coal fragments in upper 6 in	2	6
27. Shale, medium-gray, thin and evenly bedded	4	0
28. Underclay, medium-gray, fossil rootlets	1	10
29. Shale, light-grayish-brown to medium-dark-gray, thin and evenly bedded, fissile, abundant fossil plant fragments		9
Base of Lander coal bed (upper bed)		
30. Coal, bright, fine to medium cleats, abundant gypsum crystals, cleats directions are 140° at 75° SW. and 65° at 60° NW.	2	0
Top of Lander coal bed (upper bed)		
31. Shale, medium-gray, thin and evenly bedded, few thin siltstone lenses; 1-ft-6-in thick very fine grained sandstone lens 5 ft above base	13	6
32. Shale, light-grayish-brown, thin and evenly bedded, carbonaceous, scattered coal lenses, sulfur stain and gypsum crystals, abundant fossil plant fragments	1	9
33. Underclay, medium-gray, fossil rootlets		6
34. Coal, bright to dull, impure, resin blebs		2½
Top of Maverick Spring coal zone		
35. Shale, light-grayish-brown to medium-gray, thin and irregularly bedded, silty, sandy, sulfur stain, fossil plant fragments	1	2
36. Shale, medium-gray, top grades into unit 37		9
37. Sandstone, medium-light-gray, very fine grained, massive, silty, fossil roots in top part of unit	8	6
38. Underclay, medium-gray, fossil rootlets		4
39. Shale, light-grayish-brown, thin-bedded, carbonaceous, coal laminations, sulfur stain, gypsum crystals		3
40. Shale, medium-dark-gray, thin- to poorly bedded; 3-ft-thick very carbonaceous zone 5 in above base	4	0
41. Sandstone, medium-light-gray, very fine grained, silty		8
42. Shale, medium-gray, sandy, silty in basal 6 in	13	6
43. Sandstone, medium-light-gray, very fine grained, thick-bedded to massive, silty, scattered shale chips, basal 6 ft contains thin shale and siltstone beds up to 8 in thick; fossil root zone 5 in thick at base; very calcareous in top 5 ft; sandstone fills 5 ft deep channel at base	25	0
44. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to massive, abundant medium-gray to medium-dark-gray siltstone and shale laminations up to 1 ft thick, upper 5 ft very calcareous and resistant	34	0
45. Covered, probably carbonaceous shale, light-grayish-brown	15	0
Base of Signor coal bed		
46. Coal, bright attritus, fine to medium cleats, scattered resin blebs and gypsum crystals, cleats: 40° at 80° SW. and 65° at 55° NW.; unit overlain unconformably by and cut out to the northeast by unit 47 (Woodruff and Winchester, 1912, pl. L11, no. 124)	7	2
Top of Signor coal bed		
Total measured thickness of Mesaverde Formation	366	4½
Unconformity		
Lower Eocene:		
Indian Meadows Formation, conglomeratic member:		
47. Conglomerate, subrounded to well-rounded cobbles and boulders of red quartzite, shale, gray quartzite and a few igneous cobbles up to 1 ft in diameter, cobbles average 4 inches in diameter; 3-ft-thick sandy ledge 22 ft above base	50	0
48. Conglomerate, calcareous, indurated	5	0
49. Conglomerate (similar to unit 47)	70+	
Total measured thickness of Indian Meadows Formation	125	0

Measured section 16: Cody Shale through Indian Meadows Formation

Location: Hudson Quadrangle, Wyoming (7.5 min)

Start: NE–NE–SE sec. 32, T. 34 N., R. 98 W. Presented from oldest to youngest

End: NW–NE–SW sec. 33, T. 34 N., R. 98 W.

Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.

Strike 120°, Dip 10° NE.

	Thickness Ft	Thickness in.
Upper Cretaceous:		
Cody Shale:		
1. Siltstone, medium-gray, nonbedded to poorly bedded, interbedded with very fine grained sandstone and silty shale	6+	
2. Sandstone, medium-light-gray, fine- to medium-grained, dark and light mineral grains, nonresistant, basal 10 ft crossbedded; strike and dip of crossbeds 110° at 80° SW.; solution cavities, pyrite nodules, thick-bedded to massive; thin-bedded and nonresistant above 64 ft from base	109	0
3. Shale, medium-dark-gray, thin and evenly bedded, scattered siltstone and sandstone lenses, silty at top	35	0
4. Sandstone, very fine to fine-grained, dark and light mineral grains, thin and evenly bedded	7	0
5. Shale, medium-gray, scattered very fine grained sandstone and siltstone lenses, silty	35	0
6. Sandstone, very fine grained, dark and light mineral grains, thin and irregularly bedded	1	6
7. Shale, medium-gray, silty in top 6 ft	35	0
8. Sandstone, medium-light-gray, very fine grained, dark and light mineral grains, thin and evenly bedded, iron-stained	1	2
9. Shale, medium-gray, thin- to poorly bedded, silty, sandy, very sandy 1 ft below top	11	0
Total measured thickness of Cody Shale	240	8
Mesaverde Formation:		
10. Sandstone, medium-light-gray, thin and evenly bedded, dark and light mineral grains, iron-stained		8
11. Shale, medium-gray, thin and evenly bedded, thin siltstone and sandstone lenses, few fossil plant prints	15	0
12. Sandstone, light-gray, very fine grained, massive, very silty, thin-bedded at base, medium-bedded above 2 ft	10	6
13. Shale, medium-gray, thin and irregularly bedded, very sandy and silty, becomes carbonaceous at top	7	0
14. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, crossbedded at top, silty	3	0
15. Shale, medium-dark-gray, thin and irregularly bedded, very silty	2	0
16. Siltstone, medium-light-gray, thin-bedded to nonbedded	2	0
17. Shale, medium-dark-gray, thin and evenly bedded, scattered siltstone and sandstone lenses, fossil plant prints	4	0
18. Sandstone, very fine grained, sparse light and dark mineral grains, thick-bedded, very silty		10
19. Shale, medium-gray, thin and evenly bedded, scattered fossil plant prints	1	0
20. Siltstone, medium-light-gray, thin-bedded		8
Units 19 and 20 are channeled out locally, channels are filled by unit 21		
21. Sandstone, very light gray, very fine to fine-grained, light and dark mineral grains, crossbedded, thick-bedded to massive, friable, silty	20	0
22. Underclay, medium-dark-gray, thin and irregularly bedded, carbonaceous, slightly silty, fossil rootlets, abundant fossil plant prints	1	0
23. Shale, dark-gray to black, thin and evenly bedded, carbonaceous		6
24. Shale, dark-gray, thin and evenly bedded, very carbonaceous, top 1 ft wedges out westward along outcrop	4	0
25. Sandstone, very light gray, very fine grained, few fine grains, silty, abundant dark and light mineral grains, thin-bedded to massive, crossbedded, pyrite nodules, solution cavities, thin-bedded toward top	44	0
26. Shale, medium-gray, thin and evenly bedded	1	0
27. Siltstone, medium-gray, thin and evenly bedded	2	0
28. Sandstone, medium-light-gray, thin and irregularly bedded, silty		10
29. Shale, medium-gray, thin-bedded, weathered	1	0
30. Underclay, carbonaceous, fossil root and plant prints, silty		6
Base of Maverick Spring coal zone		
Base of A coal bed		
31. Coal, impure, grades vertically to carbonaceous shale; mostly bright, resin blebs		9
32. Shale, medium-gray, scattered thin siltstone and sandstone lenses, very silty	1	0
33. Shale, dark-brownish-gray, thin- to poorly bedded, carbonaceous, fossil plant prints		10
34. Coal, bright, slightly impure	1	5
Top of A coal bed		
35. Shale, dark-brownish-gray, thin- to poorly bedded, carbonaceous	2	0
36. Shale, medium-gray, thin and evenly bedded	2	5
37. Siltstone, medium-light-gray, thin-bedded to nonbedded, fossil plant prints	4	0
38. Shale, medium-gray, irregularly bedded, silty	2	0
39. Sandstone, medium-gray, fine-grained, silty		4
40. Siltstone, medium-light-gray, thin- to poorly bedded, sandy		10
41. Shale, medium-gray, thin and evenly bedded	14	0
42. Sandstone, very fine grained, crossbedded, silty	1	2
43. Shale, medium-gray, thin-bedded, silty	6	0

	Thickness	
	Ft	in
44. Underclay, light-olive-gray, fossil root and plant prints, carbonaceous in top 4 in	2	3
45. Coal, bright to dull, mostly dull, fine to medium cleats	1	10
46. Shale, medium-gray, thin and irregularly bedded, carbonaceous lower 3 in, abundant fossil plant prints	3	0
47. Shale, medium-gray, poorly bedded, very silty, sandy	2	3
48. Underclay, medium-gray, scattered fossil plant prints, very silty	4	0
Base Lander coal bed (upper bed)		
49. Coal, bright to dull, finely cleated, sandstone dikes up to 1 ft wide, locally folded; coal is sandy, top 3 in of bed appears to be detrital, as evidenced by fragments, resin blebs (Woodruff and Winchester, 1912, pl. L11, no. 134)	4	2
Top of Lander coal bed (upper base)		
50. Underclay, light-gray, silty, fossil rootlets	22	0
51. Underclay, light-gray, very silty, fossil roots, very hard		10
52. Shale, dark-brownish-gray, scattered coal fragments, carbonaceous		3
53. Underclay, light-gray, nonbedded, silty, fossil roots		4
54. Covered	10	0
Total measured thickness of Mesaverde Formation	209	2
Unconformity		
Lower Eocene:		
Indian Meadows Formation, conglomeratic member:		
55. Conglomerate, medium-light-gray, rounded cobbles and gravels, tuffaceous, chert, agate, and quartzite	10+	

Measured section 17: Cody Shale and Mesaverde Formation

Location: Alkali Butte Quadrangle, Wyoming (7.5 min)
Start: NE–SE–SW sec. 23, T. 34 N., R. 95 W. Presented from oldest to youngest
End: SE–NE–SW sec. 4, T. 2 S., R. 6 E.
Described by: R.C. Warlow and J.F. Windolph, Jr.
Strike 75°, Dip 15° NW.

	Thickness	
	Ft	in
Upper Cretaceous:		
Cody Shale:		
1. Sandstone, medium-light-gray, very fine grained, nonresistant, shale interbeds, silty	11	0
2. Sandstone, medium-light-gray, very fine grained, thick-bedded to massive, silty, scattered shale chips in basal 3 ft; top 2 ft thin-bedded, fine-grained at top, few shale interbeds	18	0
3. Shale, medium-gray, thin and evenly bedded, silty, sandy, few siltstone lenses, carbonaceous 43 ft above base; gypsum crystals; 6-in resistant sandstone 155 ft above base	185	0
4. Sandstone, medium-gray, very fine grained, silty		10
5. Shale, medium-gray, silty, scattered very fine grained sand stone lenses up to 6 in thick; gypsum crystals	50	0
6. Shale, medium-grayish-brown, bentonitic, few thin sandstone lenses 20–25 ft above base; sandy 30 ft above base	55	0
7. Sandstone, medium-light-gray, very fine grained, calcareous, silty, thin and irregularly bedded, scattered large marine pectin fossils	8	0
8. Sandstone, medium-light-gray, very fine grained, massive, silty	18	0
9. Shale, medium-gray, thin-bedded, silty, sandy, scattered siltstone lenses, slightly carbonaceous at top	11	0
10. Sandstone, light-gray, very fine grained, silty, pyrite nodules	2	5
11. Shale, medium-gray, silty, sandy, siltstone and very fine grained sandstone interbeds	10	6
12. Sandstone, light-gray, very fine grained, thin-bedded, silty, calcareous		9
13. Shale, medium-gray, siltstone and very fine grained sandstone interbeds	1	3
14. Sandstone, light-gray, very fine grained, silty, crossbedded, thin- to thick-bedded		4
15. Shale, medium-gray, very sandy, thin-bedded, slightly carbonaceous in upper 2 in	1	6
16. Sandstone, medium-light-gray, very fine grained, silty, calcareous, thin and evenly bedded		9
17. Shale, medium-gray, sandy, scattered very fine grained sandstone and siltstone lenses	19	0
18. Sandstone, medium-light-gray, very fine grained, silty, crossbedded, thin-bedded	1	10
19. Shale, medium-gray, very sandy, gypsum crystals, weathered	20	0
20. Sandstone, medium-light-gray, very fine grained, silty, thin and evenly bedded, scattered small pyrite nodules	1	5
21. Shale, medium-gray, silty	1	0
22. Sandstone, medium-light-gray, very fine grained, silty, thin and evenly bedded		4
23. Shale, medium-gray, silty, gypsum crystals	19	0
24. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded		8
25. Shale, medium-gray, scattered very fine grained sandstone lenses up to 2 in thick; gypsum crystals	19	0
26. Sandstone, medium-light-gray, very fine grained, very silty, thin-bedded, small pyrite nodules		8
27. Shale, medium-gray, silty, thin and evenly bedded	6	0

	Thickness Ft	Thickness in
28. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, abundant pyrite nodules, iron-stained and resistant in top 8 in; ripple bedded at top	10	0
29. Shale, medium-gray, very sandy, weathered	12	0
30. Sandstone, medium-light-gray, very fine grained, thin-bedded, pyrite nodules	2	1
31. Shale, medium-gray	5	6
32. Sandstone, medium-light-gray, thin- to thick-bedded, very fine to fine-grained, pyrite nodules	2	10
Total measured thickness of Cody Shale	495	8
Mesaverde Formation:		
33. Shale, medium-gray, silty, sandy, thin and evenly bedded	14	0
34. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded		7
35. Sandstone, medium-light-gray, very fine grained, very silty, nonresistant, scattered siltstone and shale lenses; resistant 9-in-thick ledge at top; bentonitic in top 2 ft	25	0
36. Sandstone, medium-light-gray to light-brownish-gray, very fine grained, slightly bentonitic, weathered	20	6
37. Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, very resistant in bottom 7 in	2	7
38. Shale, light-brownish-gray, bentonitic, sandy, gypsum crystals	2	7
39. Shale, light-grayish-brown, thin-bedded, carbonaceous, sulfur stains, gypsum crystals, sandy, scattered coal fragments, contains lens-shaped beds of flattened volcanic ash particles; crossbedded, top gradational	5	0
40. Sandstone, light-gray, very fine to fine-grained, dark and light mineral grains, crossbedded, thin-bedded, scattered shale chips	16	0
41. Sandstone, light-gray, very fine to fine-grained, pyrite nodules, thick-bedded to massive, cliff-forming, oil-stained	75	0
42. Shale, carbonaceous, silty, sandy, gypsum bands 1/4 in thick	1	4
43. Sandstone, light-gray, very fine grained, silty, fine-grained toward top, pyrite nodules in form of sunbursts, gypsum crystals	43	0
44. Sandstone, medium-light-gray, very fine grained, very silty, thin- to thick-bedded	3	6
Base of Maverick Spring coal zone		
45. Shale, medium-gray, very silty, sandstone and siltstone interbeds	2	6
46. Sandstone, medium-light-gray, very fine grained, friable, calcareous nodules up to 1 inch in diameter	8	10
47. Shale, medium-gray, silty, sandy, abundant gypsum crystals	3	8
48. Sandstone, very fine grained, very silty, thin and irregularly bedded, friable	6	2
49. Shale, medium-gray	1	6
50. Limestone, medium-light-gray, brittle, fractured		2
51. Shale, medium-gray, abundant gypsum crystals, thin and evenly bedded	1	7
52. Sandstone, very fine- to fine-grained, pyrite nodules, thin-bedded, friable	3	4
53. Shale, medium-gray, thin and evenly bedded, gypsum crystals, few fossil plant fragments	1	4
54. Sandstone, medium-light-gray, very fine grained, silty; dark-gray shale interbeds containing gypsum crystals	1	9
55. Shale, medium-dark-gray, very silty, sandstone lens 6 ft above base, oil-stained	7	0
56. Sandstone, medium-light-gray, very fine grained, oil-stained, very silty, resistant ledge 19 ft above base	28	6
57. Sandstone, very light-gray to white, friable, thin- to thick-bedded, pyrite nodules, resistant ledge 35 ft above base	46	0
58. Shale, medium-gray to medium-dark-gray, slightly carbonaceous, thin and evenly bedded, abundant gypsum crystals	15	0
59. Sandstone, medium-light-gray, very fine grained, silty, nonresistant	8	0
60. Shale, medium-gray, weathered	10	0
Top of Maverick Spring coal zone		
61. Sandstone, very light gray to white, very fine grained, massive, thin-bedded in top 10 ft, calcareous, oil-stained, silty shale lens 65 ft above base; fine-grained, few medium grains 10 ft below top; very iron stained at top	95	0
62. Shale, light-brownish-gray to brown, thin-bedded, carbonaceous, very silty, abundant sulfur crystals, fossil plant fragments, basal 6 in nonbedded	2	0
63. Shale, medium-dark-gray, thin-bedded, slightly carbonaceous, top gradational	3	0
64. Sandstone, light-gray to white, very fine grained, silty, thin- to thick-bedded, top gradational	2	6
65. Siltstone, light-grayish-brown, very silty, thin- to poorly bedded at top	1	0
Base of lower split of Signor coal bed		
66. Coal, resin blebs, fine to medium cleats, gypsum (Woodruff and Winchester, 1912, pl. L11, no. 167)	9	5
67. Shale, light-grayish-brown, thin-bedded, silty, abundant carbonaceous fragments, fossil plant impressions, gypsum crystals, sulfur-stained	5	6
68. Shale, medium-gray, gypsum crystals; thin-bedded abundant gypsum crystals in upper 1 ft	12	0

	Thickness	
	Ft	in
69. Sandstone, medium-light-gray, fine-grained, dark and light mineral grains, abundant bands of gypsum crystals and sulfur staining; abundant pyrite nodules; top 6 in very iron stained, noncalcareous, burrowed, weathers light-yellow-brown	11	6
70. Sandstone, medium-light-gray to very light gray, very fine to fine-grained, massive, solution cavities, very friable, few thin, resistant beds, top grades into silty shale	25	0
71. Shale, medium-gray, silty, thin-bedded, few silty sandstone lenses	5	0
72. Shale, light-grayish-brown, carbonaceous, few coal fragments, abundant fossil plant material	3	2
Base of upper split of Signor coal bed		
73. Coal, impure, banded, abundant carbonaceous shale laminations		4½
Top of upper split of Signor coal bed		
74. Siltstone, light-grayish-brown, very fine grained, sandstone laminations, abundant fossil plant material		5
75. Shale, medium-gray, basal 8 in light-brownish-gray, very carbonaceous, silty, thin-bedded, abundant fibrous gypsum crystals, oil-stained	3	0
76. Sandstone, medium-light-gray, very fine grained, silty, friable	2	0
77. Shale, medium-gray, thin-bedded, siltstone and sandstone interbeds, oil-stained	1	3
78. Sandstone, medium-light-gray, very fine grained, silty	1	2
79. Shale, medium-gray, thin and evenly bedded, few thin sandstone interbeds, gypsum crystals	1	6
80. Sandstone, medium-light-gray to light-gray, very fine grained, silty, oil-stained, massive, thin-bedded, resistant, iron-rich layers up to 1 ft thick scattered throughout, few crossbeds, few thin shale and siltstone lenses up to 2 ft thick; solution cavities, pyrite nodules; sandstone grades upward to fine grained, with few medium grains; very light gray 70 ft above base; few shale chips 130 ft above base; few shale lenses 130 ft above base; abundant scolithus fossils ⅛ inch in diameter in 2-ft bed at top	130	0
Unconformity		
81. Shale, grayish-brown, silty, abundant coal and carbonaceous fragments, very carbonaceous, sulfur stain, gypsum crystals		8
Base of Beaver coal bed		
82. Coal, abundant fusain in basal 10 in; impure, resin, fragmental upper portion banded, dull, poor to irregular cleats, top of bed irregular, possible detrital coal, abundant fusain at top (Thompson and White, 1952, fig. 2, loc. B, p. 3)	3	0
Top of Beaver coal bed		
83. Shale, light-grayish-brown, very silty, thin-bedded, basal 3 in contains abundant detrital coal layers, sulphur-stained, sandy at top, abundant gypsum crystals; upper 2 ft locally contains 4-in-thick coal bed	8	0
84. Siltstone, medium-gray, sandy interbeds	1	4
85. Sandstone, medium-light-gray, very fine grained, very silty, shale interbeds, noncalcareous, thin and irregularly bedded, scolithus fossils	2	2
86. Sandstone, fine- to medium-grained, light and dark mineral grains, iron-stained, solution cavities, friable, massive, pyrite nodules, oil stain	25	0
87. Shale, medium-gray, thin and irregularly bedded, carbonaceous	5	10
88. Siltstone, medium-gray, thin and irregularly bedded	2	2
89. Sandstone, medium-gray, fine-grained, iron-stained, solution cavities, pyrite nodules, resistant	2	0
90. Shale, medium-gray, thin and irregulary bedded	1	10
91. Siltstone, medium-gray, thin and irregularly bedded, oil stain	1	9
92. Sandstone, medium-gray, very fine grained interbeds of medium-gray shale, thin and evenly bedded	22	0
93. Underclay, medium-dark-brownish-gray, fossil plant material, roots		4
94. Coal, highly weathered, resin blebs, bright and dull laminations mostly dull	1	0
95. Tonstein, medium-brownish-gray, fossil plant material, basal 2 in very hard, upper 3 in weathered; carbonaceous material		5
96. Sandstone, medium-gray, fine-grained, light and dark mineral grains, solution cavities, pyrite nodules, iron-stained, thick-bedded, friable, fossil plants in medial part	5	0
97. Siltstone, medium-gray, thin and evenly bedded, abundant fossil leaves	4	0
98. Sandstone, light- to medium-gray, fine- to medium-grained, light and dark mineral grains, friable, solution cavities, pyrite nodules, massive	7	6
99. Shale, medium-brownish-gray, silty, thin and evenly bedded		9
100. Sandstone, medium-grained, light and dark mineral grains, fossil plant material, friable, pyrite nodules, thin interbeds of shale	15	0
101. Shale, medium-gray, thin and irregularly bedded, lower 1 ft carbonaceous	2	0
102. Sandstone, medium-gray, very fine to fine-grained, thin- to thick-bedded,		

	Thickness	
	Ft	in
light and dark mineral grains, oil stain, silty	4	6
103. Shale, medium-gray, thin and evenly bedded	2	4
104. Sandstone, medium-gray, very fine to fine-grained, silty, iron-stained, thin- to thick-bedded, basal 2 ft friable; interbed of shale 8 in thick, pyrite nodules	33	2
105. Shale, medium-brownish-gray, carbonaceous, thin and irregulary bedded	2	8
106. Sandstone, medium-gray, fine- to medium-grained, mostly light mineral grains, iron-stained, solution cavities, pyrite nodules	2	2
107. Sandstone, light- to medium-gray, very fine grained, thin and irregularly bedded, capped by 8-in-thick iron-stained bed	4	10
108. Underclay, medium-gray, thin and irregularly bedded, abundant fossil plants 6 in above base; abundant fossil ginkgo leaves and roots	3	2
109. Coal, dull and bright laminations, mostly dull, resin blebs, fine to medium cleats, impure	1	4
110. Shale, medium-gray, thin and irregularly bedded bottom half of unit, thin and evenly bedded top half, 4-in-thick carbonaceous shale at top, sandy at base	3	10
111. Sandstone, very fine to fine-grained, iron-stained, fossil plant material, calcareous, pyrite nodules, thin- to thick-bedded	1	4
112. Shale, medium-gray, thin and irregularly bedded	1	4
113. Sandstone, very fine to fine-grained, iron-stained, solution cavities, noncalcareous		8
114. Shale, medium-gray, thin and evenly bedded, thin and irregularly bedded carbonaceous zones	5	5
115. Shale, medium-gray, thin and evenly bedded, silty in basal 10 in; sandy in next 10 in; carbonaceous zone at top	5	2
116. Sandstone, medium-gray, very fine to fine-grained, very calcareous, solution cavities, pyrite nodules, crossbedded, thick-bedded to massive, resistant, oil stain	10	0
117. Shale, medium-gray, thin and evenly bedded	1	2
118. Siltstone, medium-gray, thin and evenly bedded, noncalcareous		6
119. Sandstone, medium-gray, silty, fossil plant fragments, friable	4	0
120. Shale, medium-gray, thin and evenly bedded	1	10
121. Siltstone, thin and irregularly bedded, iron-stained, oil stain		8
122. Sandstone, medium-gray, very fine to fine-grained, alternating resistant and friable beds, weathers to light brownish gray, fossil plant material	19	0
123. Shale, carbonaceous, abundant fossil plant material at base, highly weathered		10
124. Shale, medium-gray, thin and evenly bedded, interbeds of siltstone, carbonaceous zone, sandy in upper portion	4	0
125. Sandstone, light-medium-gray, very fine grained, silty, fossil plant material		8
126. Underclay, medium-brownish-gray, fossil plant material and roots		6
Base of Shipton coal bed		
127. Coal, bright and dull, mostly bright, very impure, amber blebs; carbonaceous shale, abundant plant material, medium-brownish-gray, thin and irregularly bedded		8
128. Shale, medium-brownish-gray, thin and irregularly bedded, carbonaceous, abundant fossil plant material		8
129. Tonstein, medium-brownish-gray, volcanic ash contains flattened phenocrysts		4
130. Underclay, very weathered, abundant fossil plant material and roots		2
131. Coal, slightly weathered, impure		6
Top of Shipton coal bed		
132. Shale, medium-dark-brownish-gray, carbonaceous, abundant fossil plant material	6	6
133. Sandstone, medium-brownish-gray, very carbonaceous, silty, abundent fossil plant material, volcanic ash in top 2 in	1	2
134. Shale, medium-gray, thin and irregularly bedded, weathers light-olive-brown, base thin and irregularly bedded, poorly bedded to nonbedded in medial part; thin-bedded, silty at top, carbonaceous material, coaly, fossil plant fragments	15	0
135. Sandstone, medium-gray, very fine to fine-grained, very calcareous, shale chips, solution cavities, pyrite nodules, thin- to thick-bedded, weathers medium-grayish-brown	12	0
136. Shale, medium-gray, thin and evenly bedded	7	6
137. Limestone, medium-gray, sandy, brittle		8
Total measured thickness of Mesaverde Formation	941	3

Measured section 17a: Mesaverde Formation through Indian Meadows Formation

Location: Alkali Butte Quadrangle, Wyoming (7.5 min)
Start: NE–SW–SW sec. 4, T. 2 S., R. 6 E. Presented from oldest to youngest
End: NW–NW–NE sec. 28, T. 1 S., R. 6 E.
Described by: N.L. Hickling and R.C. Warlow
Strike 85°, Dip 18° NW.

Upper Cretaceous:	Thickness	
Mesaverde Formation:	Ft	in
1. Sandstone, very light gray, very fine to fine-grained, dark and light mineral grains, thick-bedded to massive, noncalcareous, solution cavities; top 4 ft weathered bright brick red	19	0
2. Shale, light-brownish-gray, very sandy, carbonaceous		5
3. Sandstone, very light brownish gray, very fine grained, silty, carbonaceous, thick-bedded		6
4. Shale, dark-brownish-gray, silty, very carbonaceous, coal laminations, top gradational	1	8
5. Sandstone, light-gray, very fine grained, silty, scattered carbonaceous fragments, weathered, very iron stained in top 4 in	2	0
6. Sandstone, light-brownish-gray, very fine grained, very silty, slightly carbonaceous, thin and irregularly bedded	10	6
7. Underclay, medium-grayish-brown, very carbonaceous, fossil plants and root prints		4
Base of Shipton coal bed		
8. Coal, bright to dull, slightly impure, fine to medium cleats	1	8
Top of Shipton coal bed		
9. Shale, light-gray, very silty, thin and irregularly bedded, oil-stained	2	8
10. Siltstone, medium-light-gray, sandy toward the top, iron-stained, thin and irregularly bedded	1	10
11. Shale, medium-light-gray, thin-bedded		8
12. Siltstone, medium-light-gray, iron-stained		4
13. Shale, light-medium-gray to light-brownish-gray, slightly carbonaceous, slightly oil stained	2	0
14. Shale, medium-grayish-brown, carbonaceous, silty, thin and irregularly bedded	3	6
15. Siltstone, medium-light-gray, iron-stained, thin and irregularly bedded		7
16. Sandstone, light-gray, very fine grained, silty, thin and irregularly bedded, slightly carbonaceous	6	0
17. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded	28	0
18. Shale, medium-gray, sandy and silty, thin-bedded	5	0
19. Shale, medium-gray to medium-brownish-gray, basal 2 ft carbonaceous; scattered siltstone lenses up to 3 in thick	10	0
20. Sandstone, light-gray, slightly iron stained, thin- to thick-bedded; 6-in-thick shale 7 ft above base	27	0
21. Shale, medium-gray	3	0
22. Sandstone, medium-light-gray, very fine grained, iron-stained, thin- to thick-bedded, very calcareous	4	6
23. Shale, medium-light-gray; 6-in-thick siltstone bed 2 ft above base; few scattered siltstone and sandstone lenses up to 3 ft thick	16	0
24. Sandstone, medium-light-gray, very fine to fine-grained, iron-stained, slightly calcareous, thin and evenly bedded, crossbedded	20	0
25. Shale, medium-gray, thin and evenly bedded	2	6
26. Sandstone, medium-light-gray, very fine grained, thin-bedded, iron-stained	1	6
27. Shale, medium-light-gray, sandy, silty	4	0
28. Sandstone, light-gray, very fine grained, silty, iron-stained		8
29. Shale, medium-gray, thin and irregularly bedded, sandy, silty		8
30. Sandstone, light-gray, very fine grained, silty, iron-stained	1	0
31. Shale, medium-gray, sandy, silty	1	0
32. Sandstone, light- to medium-gray, very fine grained, iron-stained, pyrite nodules		6
33. Shale, medium-gray, silty, sandy	1	6
34. Sandstone, light- to medium-gray, very fine grained, iron-stained	1	0
35. Shale, medium-gray, silty, sandy	10	0
36. Sandstone, light-gray, weathered orange, quartzose, noncalcareous, few dark and light mineral grains, well-sorted	2	0
37. Sandstone, medium-gray, very silty, weathered, thin and irregularly bedded	22	0
38. Shale, medium-gray, thin and evenly bedded, oil-stained; 4-in-thick medium-gray siltstone lens 23 ft above base; scattered siltstone lenses up to 2 in thick	79	0
39. Sandstone, medium-light-gray, weathered orange, hard, calcareous	2	0
40. Sandstone, light-gray, very fine grained, thin-bedded	1	0
41. Shale, medium-gray, thin and irregularly bedded	1	0
42. Sandstone, light-gray, very fine grained, silty, nonresistant	5	6
43. Shale, medium-gray, thin and evenly bedded	1	0
44. Sandstone, white to light-gray, very fine to fine-grained, pyrite nodules, friable, massive, noncalcareous, upper 3 ft thin-bedded and iron-stained, crossbeds, calcareous concentrations up to 6 in thick	42	0
45. Shale, medium-gray, thin and evenly bedded	7	6
46. Sandstone, medium-gray, very fine grained, silty, nonresistant	1	6
47. Shale, medium-gray	2	6
48. Sandstone, light-medium-gray, very fine to fine-grained, thin- to thick-bedded; 6-in-thick shale lens 2 ft below top	7	0
49. Shale, medium-gray, thin and irregularly bedded	1	6
50. Sandstone, very fine grained, silty, thin-bedded, pyrite nodules	5	6
51. Shale, medium-gray, thin and irregularly bedded	6	0

	Thickness	
	Ft	in
52. Sandstone, very fine grained, iron-stained, very silty	9	0
53. Shale, medium-gray, thin and evenly bedded to thin and irregularly bedded	27	0
54. Sandstone, very fine grained, silty, iron-stained, pyrite nodules, slightly calcareous; 6-in-thick silty shale lens 8 ft above base	35	0
55. Shale, silty	8	0
56. Sandstone, very fine grained, silty, iron-stained, thin- to thick-bedded, pyrite nodules	3	6
57. Shale, medium-gray, silty, thin and irregularly bedded	7	6
58. Sandstone, very fine grained, dark and light mineral grains, thin- to thick-bedded	2	6
59. Shale, medium-gray, thin and evenly bedded	13	0
60. Sandstone, medium-gray, very fine grained, iron-stained, ripple-bedded	2	0
61. Shale, medium-gray, thin and evenly bedded	1	6
62. Sandstone, very light gray to white, very fine grained, silty, thin- to thick-bedded	5	0
63. Shale, medium-grayish-brown, very carbonaceous, fossil plant prints		8
64. Sandstone, light-gray to white, very fine grained, thin and irregularly bedded, silty	4	8
65. Shale, light-brownish-gray, carbonaceous		6
66. Sandstone, light-gray, very fine grained, silty, iron-stained	1	6
67. Shale, gray	1	0
68. Sandstone, very light gray, very fine grained, silty	1	0
69. Shale, light-brownish-gray, carbonaceous, abundant sulfur stains		4
70. Shale, medium-gray; 6-in-thick sandstone lens 8 ft above base	12	6
71. Siltstone, light-brownish-gray, thin and irregularly bedded, slightly carbonaceous	5	9
72. Sandstone, very light gray, very fine grained, nonresistant	4	4
73. Shale, light-brownish-gray, carbonaceous	1	0
74. Sandstone, very light gray, very fine grained, thin and irregularly bedded, silty, iron-stained at top	10	0
75. Underclay, dark-grayish-brown, thin-bedded, silty, hard, carbonaceous, fossil root and plant fragments	1	3
76. Coal, dull, poorly cleated	1	0
77. Shale, medium-grayish-brown, carbonaceous, fossil plants		9
78. Coal, impure, sulfur-stains	1	3
79. Tonstein, light-brownish-gray, flattened volcanic ash particles		4
80. Coal, impure, shaly	1	2
81. Tonstein, light-brownish-gray, carbonaceous lenses, sulfur stains		5
82. Coal, bright to dull, weathered		6
83. Siltstone, medium-brownish-gray, thin-bedded, carbonaceous, sandy, sulfur-stains	4	8
84. Shale, dark-grayish-brown, carbonaceous, abundant coal lenses, fossil plant prints		10
85. Coal, detrital, few bright lenses		4
86. Shale, medium-dark-brownish-gray, carbonaceous	1	0
87. Sandstone, light-gray, very fine grained, thin-bedded, silty	5	4
88. Shale, light-brownish-gray, very silty, slightly carbonaceous		8
89. Sandstone, light-gray, very fine grained, abundant sulfur stains	1	1
90. Siltstone, light-grayish-brown, thin and irregularly bedded, carbonaceous	1	3
91. Sandstone, light-gray to white, medium-grained, thin- to thick-bedded, few coarse grains; 3-in-thick carbonaceous shale lens 14 ft above basal contact	28	0
92. Shale, medium-light-gray to medium-light-brownish-gray, thin and evenly bedded, carbonaceous; 3-in-thick sandstone lens 2 ft below top; gypsum crystals	5	6
93. Sandstone, light-medium-gray, very fine grained, very silty, iron-stained, noncalcareous	1	0
94. Shale, medium-dark-gray, thin and evenly bedded, slightly carbonaceous, abundant gypsum crystals; 4-in-thick silty sandstone lens 6 in below top	5	0
95. Shale, medium-gray, thin and evenly bedded	2	0
96. Sandstone, medium-gray, very fine grained, thin-bedded, silty		4
97. Shale, medium-brownish-gray, thin and evenly bedded, carbonaceous		3
98. Sandstone, medium-gray, very fine grained, silty		3
99. Shale, medium-grayish-brown, thin and evenly bedded	2	0
100. Sandstone, light-gray, very fine grained	4	6
101. Shale, medium-brownish-gray, carbonaceous	1	6
102. Sandstone, light-gray to white, very fine grained, upper 4 in very coarse-grained, thin-bedded, abundant sulfur stains; 1-in-thick carbonaceous shale lens 4 in above basal contact	2	0
103. Shale, medium-brownish-gray, carbonaceous, oil-stained	3	0
104. Sandstone, light-gray to white, medium- to coarse-grained, bentonitic, silty, oil-stained, abundant sulfur stains	4	6
105. Shale, medium-brownish-gray, carbonaceous		8
106. Sandstone, light-gray to white, medium-grained, few coarse grains, thin and irregularly bedded, crossbedded, abundant sulfur stains	3	4
Total measured thickness of Mesaverde Formation	623	2

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		Thickness	
		Ft	in
	Unconformity: Meeteetse Formation not present		
	Lance Formation:		
107.	Shale, medium-gray, nonbedded, few scattered sandstone lenses	3	0
108.	Sandstone, light-gray to white, very fine to fine-grained, massive, few scattered carbonaceous lenses, upper 6 in iron-stained	19	6
109.	Sandstone, light-gray to white, very fine grained, few scattered carbonaceous shale lenses up to 4 in thick	4	6
110.	Shale, medium-gray, thin and evenly bedded, carbonaceous at top	2	6
111.	Sandstone, medium-gray, silty, oil-stained		6
112.	Shale, medium-gray to medium-brownish-gray, nonbedded, oil-stained	2	8
113.	Sandstone, light-gray, very fine grained, silty, abundant iron stains, lens-shaped in top 4 in	1	6
114.	Shale, medium-gray, thin and evenly bedded, slightly carbonaceous, two thin sandstone lenses 3 in thick, grades to carbonaceous shale in upper 10 in; fossil plants and coal fragments	3	6
115.	Sandstone, medium-light-gray, very fine grained, silty	6	0
116.	Shale, medium-gray, thin and irregularly bedded, silty	3	8
117.	Shale, dark-grayish-brown, carbonaceous, very silty, few fossil plant prints	1	2
118.	Sandstone, light-gray, thin- to thick-bedded, few scattered thin shale lenses	3	0
119.	Sandstone, light-brownish-gray to medium-brownish-gray, thin and irregularly bedded, shaly, carbonaceous, fossil rootlets, sulfur stains	1	3
120.	Sandstone, light-gray to white, very fine grained, silty, scattered shale lenses up to 6 in thick, some carbonaceous; upper 10 ft carbonaceous	65	0
121.	Shale, medium-brownish-gray, carbonaceous, thin-bedded to nonbedded, oil-stained	3	10
122.	Sandstone, very fine grained, thin- to thick-bedded, silty, hard, scattered gray shale lenses up to 2 ft thick, oil-stained	63	0
	Total measured thickness of Lance Formation	184	7
	Unconformity: Fort Union Formation not present		
	Lower Eocene:		
	Indian Meadows Formation:		
123.	Conglomerate, medium-light-gray, rounded quartz pebbles up to 1 inch in diameter	26	0
124.	Welded tuff, light-grayish-brown, very fine grained, hard, silicious, angular fragments, fossil roots	2	0
125.	Shale, medium-gray	9	0
126.	Sandstone, light-gray, very fine grained, very silty welded tuff bed in upper 2 ft	10	0
127.	Shale, dark-brownish-gray, very carbonaceous, silty		4
128.	Coal, impure, few bright bands up to ½ in thick, sulfur stains		4
129.	Shale, light-brownish-gray, slightly carbonaceous, sulfur stains, fossil plants, scattered silty-sandy lenses up to 1 ft thick	16	6
130.	Shale, medium-grayish-brown, very carbonaceous, fossil plant prints		6
131.	Shale, medium-gray to light-olive-gray, slightly bentonitic, carbonaceous in top 1 ft, abundant gypsum crystals	8	0
132.	Sandstone, light-gray to white, fine- to medium-grained, dark and light mineral grains, thin- to thick-bedded, scattered carbonaceous shale lenses up to 6 in thick; 1-ft-thick coarse-grained sandstone lens 13 ft above basal contact	22	0
133.	Shale, medium-gray, thin and evenly bedded, slightly carbonaceous	12	6
134.	Sandstone, light-gray to white, very fine grained, massive, very silty, upper 1 ft is very tuffaceous	4	0
135.	Sandstone, light-brownish-gray, very fine grained, thin-bedded, very silty, carbonaceous	11	0
136.	Shale, medium-gray, thin and irregularly bedded	2	0
137.	Sandstone, light-gray to white, very fine grained, massive, upper 5 ft thin-bedded; very silty, solution cavities	21	0
138.	Conglomerate, light-gray to white, yellow stains, shale chips, angular rock fragments (mostly shale chips), interbedded with very fine grained sandstone, gray to white, silty	24	0
139.	Conglomerate, light-gray to white, angular fragments 1 in above base, mostly shale chips, few carbonaceous zones	16	0
140.	Sandstone, medium-light-gray, iron-stained, scattered quartz pebbles	2	0
141.	Sandstone, light-gray, grades to medium-gray in top 1 ft; very fine grained, silty	8	0
142.	Sandstone, white, weathered	18	6
143.	Sandstone, light-gray, arkosic, calcareous, abundant feldspar grains	1	6
	Total measured thickness of Indian Meadows Formation	224	2

Measured section 18: Cody Shale and Mesaverde Formation

Location: Alkali Butte Quadrangle, Wyoming (7.5 min)
Start: SW–NE–SW sec. 25, T. 34 N., R. 95 W. Presented from oldest to youngest
End: NW–NE–SE sec. 25, T. 34 N., R. 95 W.
Described by: N.L. Hickling, R.C. Warlow, and J.F. Windolph, Jr.
Strike 150°, Dip 30° NE.

	Thickness	
	Ft	in
Upper Cretaceous:		
Cody Shale:		
1. Sandstone, weathered, oil-stained	2+	
2. Shale, medium-dark-gray to medium-gray, weathered, thin-bedded	4	6
3. Sandstone, medium-light-gray, slightly iron stained, pyrite nodules, very fine grained and very silty, top gradational; carbonaceous laminations in upper 2 in, massive		10
4. Shale, medium-gray to medium-dark-gray, weathered, poorly bedded	4	0
5. Sandstone, medium-light-gray, very fine grained, silty, calcareous, thin and evenly bedded		6
6. Shale, medium-gray, silty, thin-bedded, top gradational to sandy shale	12	6
7. Sandstone, light-gray, very fine grained, silty, thin and irregularly bedded, top gradational	2	0
8. Shale, medium-gray to medium-dark-gray, silty, upper 3 in slightly carbonaceous	3	3
9. Sandstone, light-gray, iron-stained, very fine grained, very silty, calcareous, thin- to thick-bedded, grades to silty and shaly sandstone toward top	3	0
10. Shale, medium-gray, very fine grained sandstone and siltstone interbeds; thin and evenly bedded	4	6
11. Sandstone, medium-light-gray, very fine grained, very silty, thin and irregularly bedded	1	0
12. Shale, medium-gray, few thin medium-dark-gray laminations; contains slightly carbonaceous shale bed 1 in thick and interbedded sandstone and siltstone beds about 2 in thick	5	0
13. Sandstone, light-gray, very fine grained, very silty, calcareous, dark and light mineral grains, thin-bedded	1	3
14. Siltstone, medium-gray, carbonaceous laminations, few very fine grained sandstone interbeds; thin-bedded	14	0
15. Sandstone, medium-light-gray, very fine-grained, silty, thin-bedded		8
16. Siltstone, medium-gray, very fine grained, sandstone interbeds, carbonaceous laminations, thin-bedded	3	10
17. Sandstone, medium-light-gray, very fine grained, very silty, scattered shale laminations; thin and irregularly bedded, oil-saturated	4	0
18. Shale, medium-gray, very fine grained sandstone and siltstone interbeds, thin-bedded, silty	6	6
19. Sandstone, medium-light-gray, very fine grained, silty, thin and irregularly bedded	1	0
20. Siltstone, medium-gray, very shaly, very fine grained sandstone interbeds, thin-bedded, oil stains	6	6
21. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded		8
22. Shale, medium-gray, thin-bedded, basal 4 ft very silty, sandy siltstone and sandstone interbeds	22	0
23. Sandstone, light-gray, very fine grained, very silty, thin and irregularly bedded	2	1
24. Siltstone, medium-gray, shaly, very fine grained sandstone interbeds, thin and irregularly bedded	11	0
25. Sandstone, medium-light-gray, very calcareous, very fine grained, silty, dark and light mineral grains, thin and irregularly bedded	3	6
26. Sandstone, medium-light-gray, very fine grained, abundant dark and light mineral grains, pyrite nodules, very calcareous, thin-bedded to massive, silty and shaly	6	9
27. Sandstone, light-gray, very fine to fine-grained, very calcareous, small pyrite nodules, dark and light mineral grains, nodular weathering, lenticular	3	0
28. Shale, medium-gray, thin and evenly bedded, sandy, sandstone laminations in middle part, 1-in-thick underclay, grades carbonaceous in upper 1 ft	11	10
29. Sandstone, medium-light-gray, very fine grained, silty, thick-bedded	1	1
30. Sandstone, light-gray, very fine grained, very silty, thin and irregularly bedded	5	0
31. Limestone, ferruginous, hard, brittle		1
32. Sandstone, light-gray, friable, very fine grained, silty, dark and light mineral grains, ripple-bedded at top, very calcareous, massive	4	7
33. Shale, medium-gray, very fine grained, very silty, sandy, top grades sandy, thin-bedded, top channeled and filled by overlying sandstone unit 34	2	8
Total measured thickness of Cody Shale	155	1
Mesaverde Formation:		
34. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded to massive, nodular weathering, pyrite nodules, base angular	33	0
35. Sandstone, light-gray to very light gray, very fine to fine-grained, dark mineral grains, pyrite nodules, massive-bedded, large nodular weathering, oil stains	46	0
36. Shale, medium-gray to medium-dark-gray, slightly carbonaceous, thin-bedded	5	0
37. Sandstone, medium-light-gray, very fine to fine-grained, scattered carbonaceous matter, thin- to thick-bedded	1	0
38. Shale, medium-gray, very silty and sandy, includes 3-in-thick sandstone bed; thin and irregularly bedded	2	0
39. Sandstone, medium-light-gray, very fine grained, silty, iron-stained, calcareous, massive	2	4
40. Shale, medium-gray, very silty, includes 3-in-thick sandstone bed, thin-bedded	3	6
41. Sandstone, medium-light-gray, very fine grained, very calcareous, abundant		

	Thickness	
	Ft	in
shale chips at base, thin-bedded, resistant	1	9
42. Shale, medium-gray, very silty, thin and evenly bedded	31	0
43. Sandstone, medium-light-gray, very fine grained, sparsely micaceous, calcareous, thin- to thick-bedded	1	5
44. Shale, medium-gray, thin- to poorly bedded, silty; 2½-ft-thick very fine grained sandstone 7 ft above base; 1-ft-thick very fine grained sandstone 14 ft above base; sandstone and shale chips at base	19	0
45. Sandstone, light-gray, iron-stained, calcareous, very fine to fine-grained, crossbedded, thin- to thick-bedded, irregular	2	5
46. Shale, medium-gray, very sandy, silty; sandstone interbeds up to 6 in thick; few slightly carbonaceous beds, medium-dark-gray underclay; thin and evenly bedded	21	6
47. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, silty, green and black mineral grains	5	0
48. Shale, medium-gray, thin and evenly bedded, silty; 1-ft-thick very fine grained sandstone 3½ ft above base	7	3
49. Siltstone, light-gray, thin and irregularly bedded, iron-stained		11
50. Shale, medium-gray, contains 7-in-thick very fine grained sandstone 2 ft above base, thin-bedded	5	6
51. Sandstone, medium-light-gray, very fine grained, silty, iron-stained, thin- to thick-bedded; 1-ft-thick shale lens 3 ft above base	5	0
52. Shale, medium-gray, very silty, thin-bedded	3	2
53. Sandstone, medium-light-gray, very fine grained, calcareous, thin- to thick-bedded	3	4
54. Sandstone, light-gray to white, noncalcareous, dark mineral grains, massive, iron-stained pyrite nodules up to 4 ft in diameter	44	0
55. Shale, medium-gray, thin and evenly bedded, includes very fine grained, very silty, iron-stained sandstone bed	7	0
56. Sandstone, medium-light-gray, very fine grained, very iron stained, very calcareous, thin-bedded, spongy weathering at top	1	8
57. Shale, basal 1 ft very silty, medium-gray; 1-in-shaly limestone 1 ft above base; medium-gray shale interbeds, few siltstone and sandstone interbeds up to 3 in thick; thin-bedded	28	0
58. Sandstone, light-gray, very fine grained, very silty, lenticular, pyrite nodules, solution cavities, massive-bedded	2	6
59. Shale, medium-gray, thin-bedded, very silty, sandy, few thin sandstone interbeds	11	6
60. Sandstone, very fine grained, very silty, thin-bedded, basal 4 ft thick- to massive, solution cavities, pyrite nodules	40	6
61. Shale, medium-gray, thin and evenly bedded, silty, sandy, very fine grained sandstone and siltstone interbeds, few sandstone beds up to 5 in thick	8	0
62. Sandstone, medium-light-gray, very fine grained, very silty, crossbedded, slump structures, thin- to thick-bedded, very calcareous	7	0
63. Shale, medium-gray, very silty, thin and evenly bedded, siltstone and sandstone interbeds, upper 4 ft grades into very silty, red oxidized, very fine grained sandstone	10	0
64. Sandstone, light-gray, very fine to fine-grained, pyrite nodules, 1-ft-thick shale bed 1 ft below top; noncalcareous, few fossil roots at top	60	0
65. Underclay, medium-gray, abundant fossil rootlets, carbonaceous fragments, upper 2 in very carbonaceous		4
Base of Signor coal bed		
66. Coal, bright, banded, gypsum crystals, resin blebs, fusain, fine to medium cleats, cleats 50° at 60° SE. and 150° at 45° SW.; 2-in-thick tonstein with fossil plants 1 ft 2 in below top; coal 2 in above; tonstein contains flattened volcanic ash particles	16	0
Top of Signor coal bed		
67. Shale, light-gray-brown, very carbonaceous, sulfur-stained, gypsum crystals, silty, thin and irregularly bedded	3	4
68. Siltstone, light-gray, sandy, carbonaceous shale laminations, oil stains	6	0
69. Shale, medium-gray, thin and evenly bedded, very silty, few carbonaceous laminations, siltstone and sandstone interbeds	1	11
70. Sandstone, light-gray, friable, very fine grained, silty, very calcareous, weathered, thin- to thick-bedded	6	6
71. Shale, medium-gray, thin and evenly bedded, interbeds of friable sandstone	21	0
72. Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, abundant dark and light grains, very calcareous, top gradational	7	0
73. Shale, medium-gray, very fine grained, thin-bedded, very silty, sandy	3	0
74. Sandstone, medium-light-gray, very fine grained to fine-grained, friable, abundant dark mineral grains, silty, thick-bedded to massive		3
75. Underclay, medium-gray, fossil roots, silty	1	0
76. Shale, light-gray-brown, very silty, ½-in-thick coal 2 in above base, thin- to poorly bedded	1	2

	Thickness	
	Ft	in
77. Shale, medium-gray, thin and evenly bedded		8
78. Shale, medium-light-gray, thin and irregularly bedded, sandy	1	6
79. Sandstone, light-gray, very fine grained, silty, solution cavities, pyrite nodules, crossbedded, scattered shale lenses 8 ft above base, very calcareous, silty, shaly, thin-bedded in top 10 ft	34	4
80. Shale, medium-gray, very silty, abundant siltstone and sandstone interbeds, thin-bedded	7	6
81. Sandstone, medium-light-gray, very fine grained, silty, massive, nodular weathering, dark mineral grains, grades to silty shaly sandstone in top 3 ft	22	0
82. Shale, very silty with sandstone interbeds, 1-ft-thick medium-gray shale near base	17	0
83. Sandstone, medium-gray, fine- to medium-grained, iron-stained, crossbedded, dark mineral grains, very calcareous, thin- to thick-bedded	32	0
84. Shale, thin and evenly bedded, medium gray, interbedded with nonresistant sandstone	12	0
85. Sandstone, light-gray, medium-grained, thin- to thick-bedded, solution cavities, resistant, crossbedded	33	0
86. Shale, medium-gray, thin and evenly bedded	1	0
87. Underclay, medium-gray, highly weathered, very carbonaceous in top half	1	2
Base of Beaver coal bed		
88. Coal, mostly bright, fine to medium cleats	1	0
89. Coal, bloom, highly weathered		4
Top of Beaver coal bed		
90. Shale, medium-gray, thin and irregularly bedded	1	3
91. Sandstone, medium-gray, very fine to fine-grained, thin and irregularly bedded, partly resistant, crossbedded, shale lenses up to 10 in thick, pyrite nodules	41	6
92. Underclay, medium-gray, fossil plants and rootlets, very sandy	1	0
93. Shale, medium-gray, thin and evenly bedded to thin and irregularly bedded, siltstone laminations, carbonaceous in upper 1 ft	6	0
94. Sandstone, light-gray, partly resistant, medium-grained, few coarse grains, clean, well-sorted, solution cavities, pyrite nodules, noncalcareous; very iron stained 8-in-thick sandstone	22	4
95. Sandstone and shale: Sandstone—white, fine- to medium-grained; shale—medium-brownish-gray, carbonaceous, weathered light-gray, thin and evenly bedded, carbonaceous material; 5-ft alternating beds of white sandstone and carbonaceous, shaly material; resistant	16	0
96. Sandstone, light- to medium-gray, fine-grained, solution cavities, crossbedded, pyrite nodules capped by very iron stained sandstone 8 in thick	4	4
97. Sandstone, light-gray, medium-grained, dark mineral grains, massive, resistant solution cavities, pyritic nodules, crossbedded, siltstone and very fine grained sandstone 2 ft thick, highly iron stained, slightly calcareous, very resistant at top	60	0
98. Shale, medium-gray, thin and evenly bedded	6	6
99. Sandstone, light-gray, medium-grained, dark mineral grains, massive, crossbedded, friable	38	0
100. Shale, thin and irregularly bedded, carbonaceous, silty	5	10
101. Sandstone, light-gray, medium-grained, light and dark mineral grains, massive, crossbedded, friable	37	0
102. Shale, medium-gray, thin and evenly bedded	2	0
103. Sandstone, medium-gray, fine- to medium-grained, light and dark mineral grains friable	16	0
104. Shale, dark-brown-gray, carbonaceous, irregularly bedded, resistant	1	8
105. Underclay, dark-brownish-gray, abundant fossil plants		6
106. Coal, impure, fine cleats		4
107. Shale, medium-gray, thin and irregularly bedded	4	0
108. Shale, medium-gray, fine- to medium-grained, thin and irregularly bedded, thick-bedded in upper 10 ft, iron-stained	28	0
109. Shale, medium-gray, thin and evenly bedded, few sandstone interbeds	30	0
110. Sandstone, light-gray, medium-grained, thick-bedded, crossbedded, oil stains, top 4 in ironed-stained; 1-in-thick coal at top	13	4
111. Sandstone, light-gray, medium-grained, carbonaceous laminations, medium- to dark-brownish-gray, top gradational	1	4
112. Shale, resistant, carbonaceous, thin interbeds of silty sandstone	10	2
113. Underclay, medium-dark-gray, thin and irregularly bedded	3	0
Base of lower split of Shipton coal bed		
114. Coal, mostly brown, fine to medium cleats at 85° NE., 5° at 80° NW.	4	0
115. Tonstein, medium-gray, fossil plant material, sandy with volcanic ash		8
116. Coal, impure, brown, dull laminations, weathered		5
Top of lower split of Shipton coal bed		
117. Siltstone, light-yellow-gray, thin and irregularly bedded; 4-in-thick ironstone layer	2	0

	Thickness	
	Ft	in
118. Shale, medium-gray, thin and evenly bedded, carbonaceous zones	11	0
119. Underclay, medium-dark-brownish-gray, thin and evenly bedded	4	0
Base of upper split of Shipton coal bed		
120. Coal, mostly brown, fine to medium cleats, gypsum crystals, resin blebs, petrified wood at top	4	10
Top of upper split of Shipton coal bed		
121. Shale, medium-gray, thin and evenly bedded	28	0
122. Sandstone, medium-light-gray, very fine grained, thin-bedded	1	0
123. Shale, medium-gray, thin and evenly bedded	3	0
124. Sandstone, medium-light-gray, fine-grained	6	0
125. Shale, medium-gray, silty, ripple-marked	22	0
126. Limestone, medium-gray, sandy		8
127. Shale, medium-gray, thin and evenly bedded	15	0
128. Sandstone, medium-light-gray, thin-bedded, very fine grained	2	0
Total measured thickness of Mesaverde Formation	1,110	5

Measured section 19: Mesaverde Formation

Location: Jenkins Mountain Quadrangle, Wyoming (7.5 min)

Start: NE–SE–SW sec. 26, T. 6 N., R. 2 E. Presented from oldest to youngest

End: SW–SW–NW, sec. 25, T. 6 N., R. 2 E.

Described by: F.I. Frasse

Strike 30°, Dip 25° SW.

	Thickness	
Upper Cretaceous:		
Mesaverde Formation:	Ft	in
1. Sandstone, light-gray, fine-grained, subrounded, calcareous, crossbedded, solution cavities	10	0
2. Shale (underclay), medium-brownish-gray, carbonaceous		5
3. Coal, bright, resin blebs		7
4. Tonstein, medium-brownish-gray, granules, carbonaceous		½
5. Coal, bony, fossil root prints		3
6. Shale, medium-gray, carbonaceous, poorly bedded	1	2
7. Coal, bony fossil root prints		2
8. Coal, bright, medium cleats, gypsum on cleats, fusain lenses	2	5
Top of Maverick Spring coal zone		
9. Shale, light-gray, thin and evenly bedded, calcareous sandstone interbeds	7	0
10. Sandstone, light-gray to white, very fine to fine-grained solution cavities	15	0
11. Shale (underclay), medium- to light-olive-gray, silty, fossil roots, carbonaceous in upper 6 in	1	9
12. Coal, bright, fine cleats		11
13. Shale, medium-gray, thin-bedded, carbonaceous	5	0
14. Shale, medium-gray, good fissility, carbonaceous	2	0
15. Sandstone, medium- to light-gray, very fine grained, crossbedded, calcareous cement, pyrite nodules, solution cavities	10	0
16. Shale, dark-gray, very fissile, carbonaceous, fossil roots	2	3
17. Sandstone, medium-gray, very fine grained, calcareous, pyrite nodules	5	0
18. Sandstone, light-gray to white, very fine grained, silty, massive	11	0
19. Sandstone, light-gray, fine-grained, calcareous, crossbedded, pyrite nodules	2	6
20. Shale, medium- to light-gray, thin-bedded, silty, bentonitic, fossil roots, carbonaceous	6	6
21. Sandstone, light-gray, very fine grained, thin-bedded, silty	3	6
22. Shale, medium-gray, fossil roots, bentonitic		8
23. Shale, medium-grayish-brown, very fissile, bentonitic	1	7
24. Shale, brownish-gray, poorly bedded, carbonaceous, fossil roots, bentonitic	4	6
25. Sandstone, light-gray, very fine grained, silty, thin-bedded	5	6
26. Sandstone, light- to medium-gray, very fine to fine-grained, calcareous, solution cavities		8
27. Shale, medium-gray, very fissile, carbonaceous, bentonitic, fossil root prints	1	4
28. Sandstone, light-gray to white, very fine to fine-grained, crossbedded, friable, solution cavities	5	6
29. Shale, light- to medium-gray, bentonitic, carbonaceous	6	3
30. Sandstone, light- to medium-gray, very fine grained, thin-bedded, silty, calcareous	4	7
31. Sandstone, light-gray, fine- to medium-grained, calcareous, pyrite nodules, solution cavities	1	8
32. Sandstone, light- to medium-gray, very fine grained, shale and siltstone interbeds, thin-bedded, carbonaceous	16	0
33. Sandstone, light- to medium-gray, fine- to medium-grained, calcareous, pyrite nodules, thin-bedded	8	6
34. Shale, light- to medium-gray, bentonitic, thin-bedded	4	9
35. Sandstone, light- to medium-gray, very fine to fine-grained, calcareous, thin- to thick-bedded	11	0
36. Sandstone, light-gray to white, very fine grained, calcareous, thin siltstone interbeds 10 ft above base	16	6
37. Coal, bright, banded		6

	Thickness	
	Ft	in
38. Shale (underclay), medium-gray, bentonitic, carbonaceous		8
39. Shale, light- to medium-gray, poorly bedded, bentonite, carbonaceous, fossil root prints	4	2
40. Sandstone, light-gray to white, very fine to fine-grained, crossbedded, thin- to thick-bedded, calcareous cement	10	4
41. Shale (underclay), medium-gray, poorly bedded, upper 6 in very fissile, medium-dark-gray, carbonaceous	2	6
42. Coal, dull, resin, fusain in upper 3 in		9
43. Shale (underclay), medium-gray, carbonaceous		5
44. Coal, bright, resin, banded, basal 3 in bony	2	5
45. Tonstein, medium-brownish-gray, silty, carbonaceous		1
46. Shale, medium-gray, very fissile, carbonaceous	2	0
47. Coal, bright, gypsum on cleats, upper 2 in irregular and channeled; filled by overlying sandstone unit 48	1	5
48. Sandstone, light-gray to white, fine-grained, crossbedded, thin- to thick-bedded, calcareous, friable, pyrite nodules, solution cavities	22	0
49. Shale, light- to medium-gray, poorly bedded	13	0
50. Underclay, light-grayish-brown, carbonaceous, fossil root prints		9
51. Coal, weathered, gypsum crystals		6
52. Shale, light- to medium-gray, carbonaceous zones 10 in thick at top and 9 ft above base	14	6
53. Underclay, medium-light-gray, poorly bedded, fossil root prints		8
54. Coal, dull, banded, weathered, fossil roots at base		6
55. Shale, light- to medium-gray, silty, poorly bedded, bentonitic	12	6
56. Sandstone, light-gray, fine-grained, crossbedded, thin-bedded, calcareous in upper 2 ft, pyrite nodules, solution cavities	5	5
57. Shale, medium- to light-gray, poorly bedded, silty, bentonitic, 1-in very fine grained calcareous sandstone 9 ft above base, 10-in carbonaceous zone 5 ft above base	13	6
58. Sandstone, light-gray, fine-grained, crossbedded, thin-bedded, calcareous, pyrite nodules, solution cavities	11	0
59. Shale, light-gray to brown, very silty, poorly bedded, bentonitic	13	0
60. Sandstone, medium-gray to light-brown, very fine grained, calcareous	2	0
61. Shale, light-gray, silty, poorly bedded	10	0
62. Siltstone, light-gray to white, thin-bedded, siderite bands 1 in thick at base and 1 ft 3 in thick above base	4	0
63. Shale, medium-gray, carbonaceous, bentonitic	5	6
64. Sandstone, brown, very fine grained, calcareous		3
65. Shale, light- to medium-gray, bentonitic, upper 3 ft medium-dark-gray, carbonaceous	12	0
66. Sandstone, light-gray, fine-grained, crossbedded, thin-bedded, calcareous	3	0
67. Shale (underclay), light- to medium-gray, bentonitic, upper 8 in brownish-gray, carbonaceous, fossil root prints	6	0
68. Coal, bright to dull, resin, fusain	1	7
69. Shale, medium-light-gray, bentonitic, basal 4 in carbonaceous, coal laminations	2	0
70. Sandstone, light-gray to white, fine- to medium-grained, massive at base, crossbedded, calcareous, solution cavities, pyrite nodules	12	6
71. Siltstone, light-gray, poorly bedded	5	0
72. Shale, medium-gray, bentonitic, upper 8 in medium-dark-gray, carbonaceous, fossil root prints	11	6
73. Coal, bright, resin blebs, medium cleats		2½
74. Shale, light- to medium-gray, fossil root prints	1	0
75. Sandstone, light-gray to white, very fine grained, thin-bedded, siltstone interbeds	7	6
76. Sandstone, light- to medium-gray, very fine to fine-grained, crossbedded, calcareous	15	0
77. Sandstone, light-gray, very fine grained, silty	10	0
78. Shale, light- to medium-gray, poorly bedded, silty, bentonitic	7	6
79. Sandstone, light-gray, fine-grained, crossbedded, thin-bedded, calcareous	11	6
80. Shale, light- to medium-dark-gray, upper 3 ft very fissile, carbonaceous, fossil root prints	38	0
81. Shale, light- to medium-gray, silty, bentonitic, upper half poorly bedded, fossil root prints	11	0
82. Sandstone, light- to medium-gray, fine-grained, crossbedded, thin-bedded, pyritic nodules, calcareous	6	6
83. Shale, light- to medium-gray, silty, bentonitic, thin sandstone interbeds	14	0
84. Sandstone, light-gray to white, very fine to fine-grained, crossbedded, massive, friable, calcareous	21	0
85. Shale, light-gray, silty, bentonitic, upper two-thirds interbedded with siltstone and sandstone, calcareous	15	0
86. Shale (underclay), medium-gray, carbonaceous, fossil root prints		8
87. Coal, weathered, fossil plant prints		3
88. Shale, light- to medium-gray, bentonitic	12	0
89. Sandstone, light-gray, very fine grained, silty, poorly bedded	10	6
90. Sandstone, light-gray, fine-grained, crossbedded, thin-bedded, calcareous	1	6
91. Concealed (probably shale)	46	0

	Thickness	
	Ft	in
92. Shale, light- to medium-gray, bentonitic, fossil root prints	4	4
93. Siltstone, light-gray, thin-bedded		10
94. Sandstone, light-gray, very fine grained, crossbedded, calcareous	2	6
95. Concealed (probably shale)	58	0
96. Sandstone, light-gray, very fine grained, thin-bedded, pyrite nodules, calcareous	3	0
97. Concealed (probably shale)	8	0
98. Shale, medium-gray to brown, bentonitic, carbonaceous coal laminations in upper part	2	5
99. Shale, light-gray, silty, poorly bedded	8	6
100. Sandstone, light-gray to grayish-brown, very fine grained, thin- to thick-bedded, silty, calcareous	6	0
101. Concealed (probably shale)	6	6
102. Shale, medium-gray to dark-gray, poorly bedded, silty, very carbonaceous 4 ft above base	24	0
103. Sandstone, light-gray, very fine grained to fine-grained, crossbedded, pyrite nodules, calcareous	4	6
104. Shale, light- to medium-gray, bentonitic, upper 1 ft brown, carbonaceous, fossil root prints	8	0
105. Coal, bright to dull, resin, fusain	1	0
106. Shale, medium-gray, poorly bedded, fossil rootlets, in basal 8 in carbonaceous zone, dark-brown, fossil plant fragments	10	0
107. Sandstone, light- to medium-gray, thin- to medium-bedded, crossbedded at base, fine-grained, friable, quartzose, subangular to subrounded, pyrite nodules, limestone in upper 2½ ft, well-indurated	7	0
108. Shale, light- to medium-gray, lower 7 ft silty, bentonitic, above fossil root prints	9	6
109. Sandstone, medium-yellow-brown, pyrite nodules ½ inch in diameter, siderite, quartz grains, fine-grained, well-rounded to rounded, well-indurated		11
110. Shale, light- to medium-gray, poorly to moderately bedded, lower 7 ft bentonitic, next 8 ft silty, top 3 ft silty and moderately bedded	18	0
111. Sandstone, light-brown, quartzose, fine-grained, subangular to subrounded, crossbedded, well-indurated, pyrite nodules ¼ inch in diameter	5	6
112. Shale, light-yellow-brown to medium-light-gray; basal 11 ft silty, poorly bedded, upper 14 ft less silty, moderately bedded, locally bentonitic and carbonaceous	25	0
113. Sandstone, light-yellow-brown, fine-grained, subangular to subrounded, thin-bedded, calcareous, few pyrite nodules up to ⅛ inch in diameter, small solution cavities	3	6
114. Shale, light-medium-gray, basal 4 ft silty; 6-in-thick carbonaceous shale 4 ft above base; upper 8½ ft poorly bedded to nonbedded, bentonitic, fossil root prints; top 5 in light brown, carbonaceous, slightly bentonitic	12	6
115. Coal, impure, dull and bright bands, deeply weathered		5
116. Shale, light-brown to light-medium-gray, poorly bedded, slightly bentonitic	9	3
117. Sandstone, light-yellow-orange to dark-yellow-orange, very fine to fine-grained, well-indurated, calcareous		10
118. Shale, medium-light-gray, silty, slightly bentonitic, 1-in very fine grained, calcareous sandstone, 4 ft above base; uppermost 4 ft light-brown, carbonaceous underclay, fossil root prints	13	6
119. Shale, carbonaceous, dull and impure, bony and silty, fossil root prints		8
120. Shale, dark-yellowish-orange to moderate-yellowish-brown, lower 4 ft silty, upper part poorly bedded, bentonitic	14	3
121. Sandstone, light-yellow-brown, fine- to very fine grained, thin-bedded		10
122. Shale, medium- to light-gray, silty, locally bentonitic, poorly to moderately bedded	37	0
123. Sandstone, light-yellow-brown, calcareous, well-indurated, fine-grained, subangular to subrounded, thinly crossbedded, solution cavities, pyrite nodules in discrete layers	5	6
124. Shale, light- to medium-gray, silty; upper 3 ft medium-gray, carbonaceous, locally bentonitic, poorly bedded	17	3
125. Siltstone, light-yellow-brown, calcareous, thin-bedded	1	1
126. Shale, light- to moderate-gray, bentonitic, poorly to nonbedded, 10½ ft above base is a moderate-brown, iron-cemented siltstone 2 in thick	14	6
127. Limestone, medium-gray, finely crystalline, fine-grained sandstone layers, thin- to thick-bedded, weathers dark-yellowish-orange, upper 10 in calcareous sandstone, very fine grained, few pyrite nodules up to 1 inch in diameter	2	6
128. Shale, light- to medium-gray, slightly carbonaceous, bentonitic; upper 3 ft medium gray to moderate brown, carbonaceous fossil root and plant fragments	11	0
129. Covered (shale)	22	0
130. Shale, light- to medium-gray and pale-orange-brown, lower 15 ft silty; upper 14 ft shale, bentonitic, carbonaceous, fossil roots, poorly bedded	29	0
131. Sandstone, dark-yellowish-orange to light-brown, calcareous, fine- to medium-grained, crossbedded, well-indurated, pyrite nodules	4	0

		Thickness Ft	Thickness in
132.	Sandstone, pale-yellow-brown, nonbedded, friable; 1-ft-2-in-thick siltstone at base; very fine-grained, calcareous, ferruginous cement	8	0
133.	Shale, light-medium-gray, locally bentonitic, carbonaceous, fossil roots, poorly bedded; 7 in of siltstone at base, ferruginous cement	5	3
134.	Shale, light- to medium-gray, slightly bentonitic, nonbedded	4	6
135.	Sandstone, medium-gray to moderate-brown, very fine grained, calcareous, ferruginous cement		10
136.	Shale, light-medium-gray, fossil roots, poorly bedded, slightly bentonitic	6	0
137.	Sandstone, grayish-orange, calcareous, fine-grained, thin-bedded, well-indurated, pyrite nodules up to ½ inch in diameter	2	4
138.	Shale, light- to medium-gray, nonbedded, slightly bentonitic in upper 10 in	9	8
139.	Limestone, light-greenish-gray, silty, weathers dark-yellowish-orange, thin-bedded	5	8
140.	Shale, light-medium-gray, slightly bentonitic, basal 2½ ft dark-gray, carbonaceous, upper 4 ft silty	5	6
141.	Sandstone, light- to medium-gray, very fine grained, calcareous, crossbedded, thin-bedded, pyrite nodules up to inch in diameter; base friable; upper 2½ ft well indurated	5	6
142.	Shale, light-medium-gray, moderately bedded, slightly bentonitic	4	2
143.	Sandstone, grayish-orange, fine-grained, subrounded-rounded, crossbedded, calcareous, quartzose, friable	4	0
144.	Shale, light-medium-gray; 2½-ft-thick carbonaceous shale 8½ ft above base, moderate- to light-brown, fissile, dull coal layers, slightly bentonitic	10	0
145.	Sandstone, light-gray to grayish-orange on weathered surface, fine- to very fine grained, irregular lens-shaped beds, friable, crossbedded, pyrite nodules up to 1 inch in diameter; upper 5 in moderate-brown, well-indurated, calcareous	3	5
146.	Shale, light- to medium-gray, silty, thinly laminated, bentonitic	8	0
147.	Coal, dull, impure, very deeply weathered, abundant fossil plant fragments and roots, very dark gray to dark-brown		3
148.	Shale, light-medium-gray, moderately bedded, bentonitic, carbonaceous, fossil root prints	3	6
149.	Sandstone, grayish-orange to light-gray, very fine to fine-grained, crossbedded, thin-bedded, calcareous, solution cavities, pyrite nodules, friable at base, indurated in upper 3½ ft	10	0
150.	Shale, light-gray, silty, poorly bedded, bentonitic	11	6
151.	Sandstone, grayish-orange to light-gray, very fine to fine-grained, crossbedded, thin-bedded, subangular to angular grains, abundant pyrite nodules up to ½ inch in diameter	5	10
152.	Shale, medium-gray, moderately bedded, silty in the basal 5 ft, bentonitic in the upper 3 ft 5 in	8	9
153.	Shale, dark-gray to moderate-brown, carbonaceous fossil plant fragments, slightly bentonitic, few dull coal layers	2	1
154.	Sandstone, medium-gray to yellow-orange, very fine to fine-grained, calcareous, pyrite nodules up to ⅛ inch in diameter	2	6
155.	Covered	25	0
156.	Shale, light-gray, nonbedded, bentonitic	9	0
157.	Sandstone, medium-light-gray, crossbedded, thin-bedded, fine-grained, subangular to subrounded, quartzose, well-indurated, calcareous, few pyrite nodules up to ⅛ inch in diameter	20	0
158.	Shale, light-gray, poorly bedded to nonbedded, bentonitic; 8-in-thick light-gray sandstone 3½ ft above base, quartzose, fine-grained to very fine grained, friable, subangular to subrounded	8	0
159.	Shale, medium-light-gray, few coal layers, abundant fossil plant fragments, locally bentonitic	12	6
160.	Sandstone, light-gray to medium-gray, crossbedded, thin-bedded, very fine to fine-grained, subangular, moderately quartzose, calcareous layers, indurated, few pyrite nodules, solution cavities	26	0
161.	Covered (probably shale)	17	0
162.	Siltstone, light-gray to medium-gray; basal part irregularly bedded, calcareous, indurated; upper part friable	9	0
163.	Sandstone, very light gray to white, very fine grained, very thin bedded; irregular, friable; includes limestone lens up to 1½ ft thick	23	6
164.	Siltstone, grayish-orange, irregularly bedded, well-indurated, ferruginous		8
165.	Shale, medium-gray to dark-gray, carbonaceous, fossil root and plant fragments, carbonaceous, bright coaly layers common; poorly developed fissility	1	4
166.	Siltstone, grayish-orange, ferruginous cement, irregularly bedded, well-indurated		3
167.	Shale, medium-gray to dark-gray, carbonaceous, fossil root and plant fragments, carbonaceous		10
168.	Siltstone, brownish-gray, ferruginous cement, irregularly bedded, well-indurated		11
169.	Shale, medium-gray, bentonitic, poorly bedded	14	0

		Thickness	
		Ft	in
170.	Sandstone, medium-gray, calcareous, fine-grained, crossbedded, subangular, pyrite nodules	3	6
171.	Shale, light-gray to white, slightly bentonitic, slightly carbonaceous	15	0
172.	Sandstone, medium-gray, fine-grained, moderately quartzose, subangular to rounded, pyrite nodules	35	0
173.	Shale, light-gray to medium-gray, poorly bedded, slightly bentonitic, 3 ft above base carbonaceous with fossil plant fragments	11	0
174.	Sandstone, medium-gray, very fine to fine-grained, calcareous, thin-bedded, well-indurated, pyrite nodules	2	6
175.	Shale, medium-gray, carbonaceous, bentonitic, fossil roots	2	0
176.	Covered	5	6
177.	Shale, medium-gray to dark-gray, very carbonaceous, bentonitic; 3-in-thick zone of bright coal laminae 1 ft below top	14	0
178.	Shale, medium-light-gray, silty, thin-bedded	5	4
179.	Sandstone, medium-gray, calcareous, very fine to fine-grained, weathered pyrite nodules	1	6
180.	Shale, medium-gray to white; basal 7 ft bentonitic; 8-in-thick calcareous grayish-orange siltstone; shale becomes carbonaceous in the upper 7 ft; near the top is a 1-ft-thick, dark-gray, fissile, carbonaceous shale containing bright coal laminations and a 5-in-thick bentonitic layer, medium-gray to light-olive with fossil roots; at the top is a 6-in-thick, highly carbonaceous shale, dark-gray	23	0
181.	Sandstone, medium-gray, fine-grained, crossbedded to irregularly bedded, subangular to subrounded, interbedded with carbonaceous shale	19	0
182.	Shale, light-gray to dark-gray to medium-brown, bentonitic; upper 24 ft very carbonaceous, dark-gray with fusain layers and fossil plant fragments	39	0
183.	Sandstone, medium-gray, fine-grained, calcareous, thin-bedded, well-indurated, quartzose, subrounded to rounded, pyrite nodules	12	0
184.	Shale, medium-light-gray, medium-bedded; ferruginous cemented siltstone 8 in thick 9 ft above base, and 3 in thick 14½ ft above base, bentonitic, slightly carbonaceous, few fossil plant fragments	18	6
185.	Sandstone, medium-gray to grayish-orange, fine- to medium-grained, calcareous, thin-bedded to crossbedded, solution cavities, few pyrite nodules, limonite concretions in upper part	17	6
186.	Shale, medium-gray, carbonaceous, slightly bentonitic, nonbedded, fossil plant fragments	3	9
187.	Sandstone, grayish-orange to light-gray, fine- to medium-grained, friable, calcareous, thin-bedded, ferruginous cement in basal 8 in	7	6
188.	Siltstone, light-gray, poorly bedded, slightly bentonitic in upper part	3	3
189.	Shale, light-gray to white, bentonitic, evenly bedded; 4-in-thick limestone 1 ft 3 in above base; 2-in-thick limestone 1 ft 9 in above base, overlain by a thin-bedded, 2-ft-4-in-thick, friable sandstone	11	0
	Total measured thickness of main body of Mesaverde Formation	1,571	5
White sandstone member:			
190.	Sandstone, light-gray to white, fine-grained, crossbedded	50+	—
	Total measured thickness of Mesaverde Formation	1,621	5

End of section

Measured section 20: Cody Shale through Indian Meadows Formation

Location: Eagle Point and Shotgun Butte Quadrangles, Wyoming (7.5 min)

Start: SW–SW–NW sec. 17, T. 5 N., R. 1 E. Presented from oldest to youngest

End: SE–SE–SW, sec. 15, T. 5 N., R. 1 E.

Described by: R.C. Warlow and N.L. Hickling

Strike 55°, Dip 23° NE.

		Thickness	
Upper Cretaceous:			
Cody Shale:		Ft	in
1.	Shale, light-brownish-gray, slightly silty, slightly bentonitic	30	0
2.	Sandstone, light-brownish-gray, very fine to fine-grained, thick-bedded, dark and light mineral grains, silty, very calcareous	2	8
3.	Shale, light-brownish-gray, silty, slightly calcareous	12	9
4.	Sandstone, light-brownish-gray, very fine to fine-grained, thin and evenly bedded, dark and light mineral grains, micaceous, very silty		5
5.	Shale, light-brownish-gray, very silty, weathered	4	5
6.	Sandstone, light-brownish-gray, very fine grained, thin and irregularly bedded, very silty		4½
7.	Shale, light-brownish-gray, very silty, weathered	13	6
8.	Sandstone, light-brownish-gray, very fine grained, thin and irregularly bedded, low quartz content, dark and light mineral grains, very calcareous	1	7
9.	Shale, light-brownish-gray, very silty, sandy, top gradational	2	8
10.	Sandstone, light-brownish-gray, very fine grained, thin and irregularly bedded,		

	Thickness	
	Ft	in
low quartz content, few dark and light mineral grains, slightly calcareous	1	8
11. Shale, light-brownish-gray, very silty, sandy	4	0
12. Sandstone, light-brownish-gray, very fine to fine-grained, thick-bedded, abundant dark and light mineral grains, micaceous, very calcareous	1	5
13. Sandstone, light-brownish-gray, very fine to fine-grained, thin and irregularly bedded, crossbedded, resistant ledges up to 9 in thick, weathered	21	9
14. Shale, light-brownish-gray, silty, weathered	21	9
15. Sandstones, light-gray, very fine to fine-grained, thin- to thick-bedded, dark and light mineral grains		11
Total measured thickness of Cody Shale	119	11
Mesaverde Formation:		
16. Shale, medium-gray, very silty, slightly carbonaceous	2	0
17. Sandstone, light-gray, very fine grained, thin to thick and irregularly bedded, dark and light mineral grains, scattered carbonaceous matter	5	0
18. Sandstone, light-gray, fine-grained, thick-bedded to massive, dark and light mineral grains, solution cavities, pyrite nodules up to ½ inch in diameter, light-gray shale lenses up to 1 ft thick, thin-bedded and calcareous in top 5 in, coarse-grained in upper 30 ft	135	0
19. Shale, medium-gray, silty, sandy, weathered	8	9
20. Sandstone, light-brownish-gray, very fine to fine-grained, thick-bedded to massive, dark and light mineral grains, abundant pyrite nodules up to ½ inch in diameter	4	4
21. Sandstone, light-gray, very fine grained, thin and irregularly bedded, dark and light mineral grains, very friable	4	0
22. Siltstone, light-brownish-gray to medium-gray, thin and irregularly bedded, sandy	6	0
23. Sandstone, medium-gray, very fine grained, thin and irregularly bedded, sandy	6	0
24. Shale, medium-dark-gray, slightly carbonaceous, silty, poor fissility, scattered fossil plant fragments	2	4
25. Underclay, dark-grayish-brown, abundant fossil plant fragments	2	4
26. Shale, dark-brownish-gray, carbonaceous, very fissile, abundant fossil plant fragments	1	5
27. Underclay, dark-brown, abundant fossil root prints		3
Base of Maverick Spring coal zone		
28. Coal, very finely cleated, mostly bright, weathered, scattered sulfur stains, gypsum crystals	1	3
29. Shale, medium-grayish-brown, very carbonaceous, silty, gypsum crystals, fossil plant fragments	1	5
30. Shale, medium-dark-gray, poor fissility, abundant gypsum crystals	2	1
31. Siltstone, light-brownish-gray, thin and irregularly bedded, fossil plant fragments, weathered	2	3
32. Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty, finely micaceous, very calcareous	1	3
33. Sandstone, medium-brownish-gray, very fine grained, thin and irregularly bedded, very calcareous in top 1 ft	4	0
34. Siltstone, light-gray, lens-shaped, sandy	1	2
35. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, silty, mica flakes, very calcareous	2	10
36. Underclay, dark-brownish-gray, abundant carbonaceous fragments, gypsum crystals, top contact gradational	3	0
37. Shale, dark-brownish-gray, poor fissility, scattered fossil plant fragments, gypsum crystals, carbonaceous	2	8
38. Sandstone, light-gray, very fine grained, thin- to thick-bedded, ripple-bedded in top 6 in; dark and light mineral grains, fossil plant fragments, pyrite nodules up to ½ inch in diameter, very calcareous	5	8
39. Shale, medium-grayish-brown, poor fissility, silty, scattered fossil plant fragments	1	2
40. Sandstone, light-gray, very fine grained, thin and irregularly bedded, dark and light mineral grains		4
41. Shale, medium-brownish-gray, poor fissility, silty, scattered fossil plant fragments	1	1
42. Shale, medium-dark-gray, nonfissile, slightly carbonaceous, scattered fossil plant fragments		9
43. Shale, medium-dark-gray, carbonaceous, abundant fossil plant fragments, gypsum crystals		3
44. Siltstone, light-olive-gray, abundant fossil plant fragments		4
45. Shale, dark-brownish-gray, fair fissility, abundant fossil plant fragments		10
46. Sandstone, very light gray, very fine grained, thin-bedded, silty	1	1
47. Sandstone, very light gray, very fine grained, thin-bedded, very silty, carbonaceous		10
48. Sandstone, light-gray, very fine grained, thin-bedded to nonbedded, siltstone interbeds, very carbonaceous; scattered coal lenses up to ¼ in thick, abundant fossil plant fragments		6
49. Underclay, dark-brownish-gray, abundant coal fragments and lenses up to ⅛ in thick, abundant gypsum crystals and fossil plant fragments		4

		Thickness	
		Ft	in
50.	Coal, bright to dull, weathered, impure		2
51.	Underclay, dark-brownish-gray, very carbonaceous, coal lenses up to ⅛ in thick, scattered fossil plant fragments		5
52.	Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, dark and light mineral grains, pyrite nodules up to ¼ inch in diameter, calcareous	4	11
53.	Shale, medium-brownish-gray, silty, sandy, weathered		4
54.	Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty		4
55.	Siltstone, light-olive-gray, sandy, fossil plant fragments		11
56.	Shale, medium-brownish-gray, poor fissility, carbonaceous, scattered fossil plant fragments, abundant gypsum crystals	1	1
57.	Underclay, medium-gray, silty, sandy, finely micaceous, scattered fossil plant fragments and roots	1	2
58.	Coal, impure, weathered, abundant shale lenses up to ⅛ in thick		6
59.	Shale, gray, carbonaceous		4
60.	Siltstone, light-olive-gray, sandy		8
61.	Sandstone, light-gray, fine-grained, thick-bedded to massive, dark and light mineral grains, pyrite nodules up to 1 inch in diameter, solution cavities up to 6 inches in diameter, very calcareous	8	0
62.	Siltstone, light-olive-gray, sandy, weathered	1	3
63.	Shale, light-olive-gray, poor fissility, scattered fossil plant fragments, slightly carbonaceous	2	1
64.	Sandstone, light-gray, very fine grained, thick-bedded, abundant dark and light mineral grains, micaceous	1	7
65.	Shale, medium-gray, gypsum crystals, slightly carbonaceous		8
66.	Coal, bright to dull, finely cleated, gypsum crystals, weathered		9
67.	Shale, dark-brownish-gray, fair fissility, gypsum crystals, carbonaceous	1	4
68.	Shale, medium-dark-gray, poor fissility, scattered fossil plant fragments	1	9
69.	Sandstone, light-gray, very fine grained, finely micaceous, silty		10
70.	Shale, light-brownish-gray, slightly carbonaceous, weathered	3	0
71.	Underclay, light-brownish-gray, scattered fossil plant fragments, silty		7
72.	Shale, dark-brownish-gray, abundant fossil plant fragments, gypsum crystals, very carbonaceous		3
73.	Coal, mostly dull, impure, abundant gypsum crystals		8
74.	Shale, medium-brownish-gray, fair fissility, silty, abundant fossil plant fragments, carbonaceous		9
75.	Shale, medium-gray, fissile, slightly carbonaceous, weathered	4	0
76.	Sandstone, light-gray, very fine grained, thin and irregularly bedded, ripple-bedded at top, pyrite nodules, iron-stained	4	6
77.	Shale, medium-gray, weathered	2	2
78.	Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty, dark and light mineral grains	1	10
79.	Shale, medium-dark-gray, abundant fossil plant fragments, scattered siltstone lenses up to 2 in thick, carbonaceous, weathered	3	0
80.	Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty, slightly calcareous, iron-stained	3	2
81.	Shale, medium-light-gray, gypsum crystals, weathered	1	0
82.	Siltstone, light-gray, thin and irregularly bedded, iron-stained		10
83.	Shale, light-olive-gray, weathered		7
84.	Sandstone, light-gray, very fine grained, thin- to thick-bedded, silty, pyrite nodules up to ¼ inch in diameter, unit is lens-shaped	1	2
85.	Shale, medium-gray, slightly carbonaceous, weathered	3	1
86.	Sandstone, medium-gray, very fine grained, thin-bedded, silty, abundant carbonaceous fragments		5
87.	Shale, medium-gray, poor fissility, very silty, scattered fossil plant fragments, grades carbonaceous upward	1	0
88.	Underclay, medium-brownish-gray, silty, abundant fossil roots, scattered coal fragments		7
89.	Coal, mostly dull, medium cleats, abundant sulfur stains		5
90.	Tonstein, light-pinkish-gray, abundant flattened volcanic ash particles		½
91.	Coal, mostly dull, medium cleats, abundant sulfur stains and gypsum crystals		5½
92.	Underclay, dark-brownish-gray, very silty, scattered fossil roots, scattered fossil plant fragments	2	1
93.	Coal, weathered		1
94.	Shale, medium-gray, weathered		3
95.	Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, silty, abundant dark mineral grains	5	8
96.	Shale, medium-brownish-gray, poor fissility, abundant fossil plant fragments, carbonaceous	1	3
97.	Underclay, dark-brownish-gray, very silty, abundant coal and fossil plant fragments, very carbonaceous		5
98.	Coal, bright to dull, finely cleated, gypsum crystals		4
99.	Shale, dark-brownish-gray, abundant coal fragments, very carbonaceous		6
100.	Coal, dull, very impure		8
101.	Coal, bright to dull, finely cleated		6
102.	Shale, medium-brown-gray, slightly carbonaceous, scattered plant fragments, top gradational	2	3
103.	Sandstone, very fine grained, very silty, thin and irregularly bedded	1	10

	Thickness	
	Ft	in
104. Shale, light-olive-gray, very silty, weathered, poorly fissile	1	6
105. Siltstone, light-brownish-gray, weathered, sandy, scattered fossil plant fragments, thin-bedded		7
106. Shale, medium-gray, very weathered		11
107. Sandstone, light-gray, very fine grained, very silty, lens-shaped	1	4
108. Underclay, dark-brownish-gray, very carbonaceous, scattered coal fragments		3
109. Coal, dull, impure, weathered		9
110. Shale, light-olive-gray, carbonaceous, fissile, scattered fossil plant material	1	2
111. Siltstone, light-gray, thin and irregularly bedded, sandy	2	0
112. Sandstone, light-gray, very fine grained, weathered		8
113. Underclay, medium-olive-gray, scattered fossil roots and plant fragments, silty, hard		4
114. Coal, dull, impure		2½
Top of Maverick Spring coal zone		
115. Underclay, light-olive-gray, abundant carbonaceous fossil plant fragments, abundant coal lenses, silty		9
116. Shale, dark-gray to black, carbonaceous, weathered		1
117. Underclay, medium-gray, fossil plant material, top gradational		5
118. Sandstone, light-gray, fine- to medium-grained, thick-bedded to massive, solution cavities, dark and light mineral grains, crossbedded	48	0
119. Siltstone, medium-gray, weathered, gray mineral grains	1	1
120. Shale, medium-gray to dark-brownish-gray, carbonaceous, abundant fossil plant material, weathered	2	3
121. Shale, dark-brownish-gray, very carbonaceous, abundant gray minerals, fossil plant fragments; 2-in-thick silty zone 8 in above base	1	0
122. Coal, bright to dull, weathered		3
123. Tonstein, light-pinkish-gray, scattered volcanic ash fragments		2
124. Coal, bright to dull, weathered, finely cleated		2
125. Tonstein, light-pinkish-gray, scattered carbonaceous fragments		3
126. Shale, brownish-gray, abundant coal lenses up to ¼ in thick		3
127. Coal, bright to dull, weathered, medium cleats, abundant sulfur stains and gray minerals		11
128. Shale, dark-brownish-gray, very carbonaceous, fissile, abundant coal fragments		9
129. Sandstone, light-gray, very fine to fine-grained, silty, thin and irregularly bedded	1	3
130. Shale, medium-dark-gray, carbonaceous, scattered fossil plant fragments	1	4
131. Sandstone, light-gray, very fine grained, crossbedded, silty, light and dark mineral grains, pyrite nodules ¼ inch in size	4	3
132. Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty	6	10
133. Shale, medium-gray, weathered	2	5
134. Underclay, dark-brownish-gray, carbonaceous, thin tonstein laminations		4
135. Coal, bright to dull, weathered, gypsum crystals		5
136. Shale, medium-brownish-gray, carbonaceous, abundant coal fragments, top gradational	1	2
137. Sandstone, very fine to fine-grained, thin- to thick-bedded, calcareous, abundant dark to light mineral grains, pyrite nodules up to 1 inch in diameter, solution cavities	7	0
138. Shale, medium-gray, weathered, slightly carbonaceous	2	11
139. Siltstone, light-medium-gray, thin and irregularly bedded	1	3
140. Shale, medium-gray, weathered	1	0
141. Shale, light-pinkish-gray, carbonaceous, abundant fossil plant fragments	1	3
142. Shale, medium-dark-gray, very silty, carbonaceous, scattered fossil plant fragments	1	3
143. Shale, medium-gray, slightly carbonaceous, highly weathered, scattered fossil plants	7	0
144. Shale, medium-dark-gray, carbonaceous, weathered, silty toward top	4	9
145. Sandstone, light-gray, very fine grained, thin-bedded, crossbedded, dark and light mineral grains, pyrite nodules up to ¼ inch in diameter		11
146. Shale, medium-gray, highly weathered	7	6
147. Shale, dark-brownish-gray, very carbonaceous, abundant coal fragments		5
148. Sandstone, light-gray, very fine to fine-grained, thin and irregularly bedded, abundant dark and light mineral grains, scattered carbonaceous material, lens-shaped	3	9
149. Shale, medium-gray, weathered		8
150. Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty	3	0
151. Shale, medium-gray, weathered	3	7
152. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, dark and light minerals, iron-stained	7	3
153. Siltstone, medium-gray, weathered, sandy	8	6
154. Sandstone, light-gray, very fine grained, thin- to thick-bedded, scattered fossil plant fragments	2	10
155. Shale, medium-gray, weathered	1	0
156. Coal, bright to dull, highly weathered, impure		7
157. Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, dark and light minerals, solution cavities	2	8
158. Shale, medium-gray, weathered	1	10

	Thickness	
	Ft	in
159. Underclay, medium-brownish-gray, carbonaceous, fossil root prints		2
160. Coal, bright to dull, medium cleats, impure, weathered, scattered shale lenses up to ½ in thick		6
161. Siltstone, light-gray, weathered	2	7
162. Sandstone, medium-light-gray, very fine to fine-grained, thin to thick and irregularly bedded, noncalcareous, iron-stained, pyrite nodules up to ¼ in thick, solution cavities	4	0
163. Shale, medium-gray, weathered	1	6
164. Sandstone, light-gray, fine to medium-grained, dark and light mineral grains, crossbedded, calcareous	2	10
165. Shale, medium-gray, weathered	1	6
166. Sandstone, light-gray, fine-grained, thin- to thick-bedded, dark and light minerals, resistant, lens-shaped	3	3
167. Sandstone, light-gray, fine-grained, thin and irregularly bedded, dark and light minerals, very calcareous	15	0
168. Siltstone, light-gray, sandy, weathered	3	0
169. Sandstone, medium-light-gray, thin- to thick-bedded, dark and light minerals, very calcareous	25	0
170. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, abundant dark and light minerals, abundant pyrite nodules up to 1 in thick, solution cavities, calcareous	22	0
171. Shale, light-olive-gray, weathered	7	0
172. Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty, few pyrite nodules up to ¼ in thick, iron-stained, lens-shaped	2	4
173. Shale, medium-gray, very silty, bentonitic, weathered, top gradational	21	0
174. Sandstone, light-gray, very fine grained, thin- to thick-bedded, scattered pyrite nodules up to ¼ inch in diameter, iron-stained, finely micaceous, calcareous	14	0
175. Shale, light-olive-gray, weathered	13	0
176. Sandstone, light-gray, weathered, nonresistant	2	0
177. Shale, medium-gray, weathered	3	6
178. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, resistant, very calcareous, iron-stained, few solution cavities	5	0
179. Limestone, medium-light-gray, very finely crystalline, conchoidal fracture, slightly iron stained, brittle	2	1
180. Sandstone, light-gray, very fine grained, thin and irregularly bedded, dark and light minerals, iron-stained, calcareous, lens-shaped		8
181. Shale, medium-gray, silty, contains 6-in-thick siltstone lens 2 ft above base, weathered	7	0
182. Sandstone, very fine grained, thin and irregularly bedded, finely micaeous, nonresistant	1	3
183. Shale, medium-gray, slightly carbonaceous, slightly bentonitic, weathered	1	2
184. Sandstone, light-gray, very fine grained, thin- to thick-bedded, dark and light minerals, silty	6	0
185. Shale, medium-dark-gray, carbonaceous, scattered fossil plant fragments, weathered	3	0
186. Sandstone, light- to medium-gray, very fine grained, very silty, nonresistant		5
187. Shale, light-brownish-gray, slightly carbonaceous, weathered	6	6
188. Sandstone, light-gray, very fine grained, thin- to thick-bedded, iron-stained	5	0
189. Shale, light-olive-gray, weathered	1	4
190. Siltstone, light-gray, weathered, iron-stained, nonresistant, scattered fossil plants		9
191. Shale, medium-gray	1	1
192. Sandstone, very light gray, very fine grained, weathered, nonresistant		11
193. Shale, medium-gray, weathered		11
194. Sandstone, light-gray, very fine grained, very silty, weathered, nonresistant		5
195. Shale, medium-gray, weathered	1	2
196. Sandstone, very fine to fine-grained, thin and irregularly bedded, dark and light mineral grains, nonresistant		6
197. Siltstone, light-gray, sandy, nonresistant		9
198. Underclay, dark-brownish-gray, very carbonaceous, weathered, scattered fossil plant material		5
199. Coal, bright to dull, highly weathered	1	0
200. Shale, medium-gray, weathered, slightly bentonitic	5	6
201. Sandstone, light-gray, very fine to fine-grained, thick- to thin-bedded, dark and light minerals, iron-stained, pyrite nodules up to ½ inch in diameter	20	0
202. Sandstone, light-gray, very fine grained, silty, very calcareous, abundant carbonaceous fragments, iron-stained	1	9
203. Shale, light-olive-gray, poor fissility, scattered carbonaceous fragments	2	1
204. Sandstone, light-gray, fine-grained, thin- to thick-bedded, abundant dark and light mineral grains, pyrite nodules up to ¼ inch in diameter	3	8
205. Shale, light-olive-gray to medium-gray, slightly carbonaceous, slightly bentonitic, poor fissility, scattered fossil plant fragments	5	6
206. Sandstone, light-gray, very fine grained, thin- to thick-bedded, silty, nonresistant	3	0
207. Underclay, light-gray, very silty, abundant fossil plant fragments, hard	3	1
208. Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty, iron-stained; 1-ft-thick medium-gray shale lens 2 in above base	7	6
209. Shale, medium-gray, scattered fossil plant material, weathered	1	0

	Thickness	
	Ft	in
210. Sandstone, light-gray, thin and irregularly bedded, very silty		4½
211. Shale, medium-gray, weathered, poor fissility		5
212. Sandstone, medium-light-gray, very fine grained, thin to thick and irregularly bedded	2	0
213. Shale, medium-dark-gray, highly weathered, scattered carbonaceous fragments	1	10
214. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, few dark and light minerals, lens-shaped, pyrite nodules up to ¼ inch in diameter	1	6
215. Shale, medium-gray, highly weathered	3	0
216. Siltstone, light-gray, thin and irregularly bedded, sandy, iron-stained, contains 1½-in-thick shale lens 6½ in above base	2	11
217. Shale, medium-gray, silty, poor fissility, weathered, scattered fossil plant fragments, top gradational	1	0
218. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, finely micaceous, iron-stained, scattered fossil plant leaves	1	9
219. Shale, light-olive-gray- to medium-dark-gray, weathered, scattered fossil plant fragments	1	2
220. Siltstone, medium-gray, iron-stained, calcareous		8
221. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty		11
222. Shale, medium-dark-gray, weathered, scattered fossil plant fragments		2
223. Underclay, medium-brownish-gray, very carbonaceous, coal fragments and scattered fossil plant fragments		3
224. Shale, light-olive-gray, weathered	7	0
225. Sandstone, light-gray, very fine to fine-grained, dark and light minerals, thin and irregularly bedded, very silty, scattered carbonaceous fragments, iron-stained	6	6
226. Shale, light-olive-gray to medium-gray, very silty, highly weathered	5	0
227. Sandstone, light-medium-gray, very fine grained, thin to thick and irregularly bedded, dark and light minerals, very calcareous	11	0
228. Shale, medium-light-gray, highly weathered		8
229. Coal, highly weathered		2+
230. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, iron stains, nonresistant	3	6
231. Shale, medium-gray, weathered		11
232. Sandstone, medium-gray, very fine grained, nonresistant	3	6
233. Shale, light-olive-gray, highly weathered		7
234. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, dark and light minerals, silty	1	0
235. Shale, medium-gray, bentonitic, weathered	3	6
236. Sandstone, medium-gray, very fine grained, dark and light minerals, weathered		6
237. Shale, medium-light-gray, bentonitic, fossil plant fragments	3	10
238. Siltstone, medium-light-gray, very calcareous, iron-stained		1
239. Shale, medium-gray, weathered		3
240. Siltstone, medium-gray, weathered		1
241. Shale, medium-gray, weathered		2½
242. Siltstone, medium-gray, weathered		1
243. Shale, medium-gray, carbonaceous fragments	1	1
244. Sandstone, very fine grained, thick-bedded, dark and light minerals, silty	2	0
245. Shale, medium-gray, weathered	5	6
246. Sandstone, medium-light-gray, very fine grained, dark and light minerals, silty, finely micaceous	1	0
247. Shale, medium-gray, slightly carbonaceous, bentonitic	7	0
248. Shale, dark-grayish-brown, very carbonaceous, abundant fossil plant fragments, scattered coal fragments		5
249. Shale, medium-gray to light-olive-gray, bentonitic, weathered	3	0
250. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty	1	3
251. Shale, medium-gray, weathered	1	4
252. Siltstone, medium-gray, weathered	1	0
253. Shale, medium-dark-gray, slightly carbonaceous, slightly bentonitic, weathered, top gradational	1	7
254. Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, solution cavities, pyrite nodules up to to ½ inch in diameter	1	7
255. Shale, medium-dark-gray, weathered	1	1
256. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, dark and light minerals, very silty, finely micaceous		10
257. Shale, dark-brownish-gray, carbonaceous, scattered fossil plant fragments, grades upward to light-olive-gray	2	3
258. Sandstone, light-gray, very fine to fine-grained, thin and irregularly bedded, nonresistant	1	3
259. Shale, medium-light-gray, weathered		4
260. Sandstone, medium-light-gray, very fine to fine-grained, crossbedded, abundant dark and light mineral grains, silty, calcareous, iron-stained	3	10
261. Shale, medium-gray, weathered	2	0
262. Sandstone, medium-light-gray, very fine grained, thin to thick and irregularly bedded, crossbedded, silty	18	0

		Thickness	
		Ft	in
263.	Shale, medium-gray, silty, weathered	2	0
264.	Sandstone, very fine to fine-grained, thin- to thick-bedded, silty, solution cavities, pyrite nodules up to ½ in thick, irregular base fills channel into underlying units	13	0
265.	Shale, medium-gray, weathered	6	0
266.	Siltstone, medium-gray, sandy, iron-stained	1	0
267.	Shale, medium-gray, weathered	6	3
268.	Shale, dark-grayish-brown, very carbonaceous, scattered fossil plant fragments, scattered carbonaceous material		8
269.	Shale, medium-gray, weathered	5	0
270.	Sandstone, medium-light-gray, very fine to fine-grained, thin to thick and irregularly bedded, crossbedded, dark and light minerals, very calcareous, finely micaceous	10	0
271.	Shale, medium-light-gray, weathered, abundant fossil plant fragments		7
272.	Coal, highly weathered		8
273.	Shale, medium-gray, weathered		6
274.	Sandstone, light-gray, very fine to fine-grained, thick-bedded, silty, nonresistant, pyrite nodules up to ⅛ inch in diameter	1	9
275.	Shale, medium-gray, slightly bentonitic, highly weathered	2	3
276.	Siltstone, highly weathered		1
277.	Shale, medium-gray to light-olive-gray, highly weathered	10	6
278.	Sandstone, light-gray, very fine grained, thick-bedded, dark and light mineral grains	4	0
279.	Shale, medium-light-gray, highly weathered	5	0
280.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded to massive, dark and light mineral grains, solution cavities, pyrite nodules up to 1 inch in diameter	56	0
281.	Shale, medium-gray, weathered	1	0
282.	Sandstone, very fine grained, silty, nonresistant		6
283.	Shale, medium-gray, slightly carbonaceous, grades to light-olive-gray in top 1 ft	3	2
284.	Sandstone, light-gray, very fine grained, thin to thick and irregularly bedded, very silty	2	0
285.	Shale, medium-gray, weathered		11
286.	Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, crossbedded, scattered shale lenses up to 4 in thick, pyrite nodules up to ⅛ inch in diameter	5	8
287.	Underclay, dark-brownish-gray, abundant fossil plant fragments, abundant coal fragments		7
288.	Coal, weathered		2
289.	Shale, medium-brownish-gray, weathered	2	2
290.	Shale, light-olive-gray, slightly bentonitic	7	0
291.	Sandstone, medium-light-gray, very fine grained, thin to thick and irregularly bedded, lens-shaped, irregular base fills channels 2 ft deep in unit 290	6	6
292.	Shale, medium-gray, weathered	5	0
293.	Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, dark and light mineral grains, shale lenses up to 4 in thick, few pyrite nodules up to ⅛ inch in diameter	7	6
294.	Shale, medium-gray to light-olive-gray, slightly bentonitic	8	0
295.	Underclay, medium-brownish-gray, silty, sandy, slightly carbonaceous, scattered fossil roots		9
296.	Coal, mostly bright		1
297.	Shale, medium-gray, weathered, fairly fossiliferous	1	10
298.	Underclay, dark-brownish-gray, very silty, slightly carbonaceous, abundant fossil plant fragments	1	1
299.	Shale, medium-dark-gray		6
300.	Sandstone, medium-light-gray, very fine grained, silty, nonresistant		10
301.	Shale, medium-dark-gray, weathered	2	11
302.	Sandstone, light-gray, thin and irregularly bedded, very silty		11
303.	Shale, medium-gray, weathered	1	0
304.	Underclay, medium-brownish-gray, carbonaceous, abundant fossil plant fragments, abundant scattered coal fragments, abundant sulfur stains		7
305.	Coal, mostly bright, finely cleated, gypsum crystals		3
306.	Shale, dark-gray, carbonaceous, scattered fossil plant fragments		7
307.	Shale, light-olive-gray, slightly bentonitic, top gradational	6	2
308.	Sandstone, light-gray, very fine grained, thin and irregularly bedded, crossbedded, dark and light mineral grains, very silty, some iron staining	2	1
309.	Shale, light-olive-gray, weathered, scattered siltstone lenses up to 1 in thick	7	8
310.	Sandstone, medium-light-gray, very fine grained, very silty, nonresistant		5
311.	Underclay, medium-gray, very silty, hard, abundant fossil plant fragments, abundant scattered coal fragments, abundant gypsum fragments		6
312.	Shale, medium-dark-gray, carbonaceous, silty, abundant fossil plant fragments		5
313.	Shale, light-olive-gray, weathered	2	0
314.	Shale, light-brownish-gray, carbonaceous, weathered, silty		7
315.	Shale, light-olive-gray, weathered	3	10
316.	Siltstone, light-gray, thin and irregularly bedded		6
317.	Shale, light-olive-gray, silty, weathered, scattered silty lenses up to 1 in thick	4	2

	Thickness	
	Ft	in
318. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty		10
319. Shale, olive-gray, slightly carbonaceous		10
320. Underclay, dark-brownish-gray, silty, hard, abundant fossil plant fragments, scattered coal lenses up to 1½ in thick; resistant ledge in top 4 in	1	7
321. Shale, light-olive-gray, weathered, contains 2-in siltstone lens 2½ ft above base, top gradational	6	0
322. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, crossbedded, very silty, some iron stains	2	2
323. Shale, light-olive-gray, very silty in top 1 ft, weathered, top gradational	8	6
324. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, pyrite nodules up to ⅛ inch in diameter	1	7
325. Shale, light-olive-gray, silty, sandstone lenses	1	2
326. Underclay, dark- brownish-gray, silty, hard, very carbonaceous		1½
327. Coal, bright attritus, fine to medium cleats, gypsum crystals		7
328. Underclay, medium-brownish-gray, silty, hard, abundant carbonaceous fragments		11
329. Shale, light-olive-gray, scattered silt lenses, weathered	5	0
330. Shale, medium-dark-gray, carbonaceous, silty		6
331. Shale, light-olive-gray to medium-dark-gray, top gradational	3	0
332. Sandstone, very fine grained, thick to thin and irregularly bedded, very silty, very calcareous; 2-in-thick siltstone lens 1 ft 8 in below top	10	0
333. Shale, light-olive-gray to medium-gray, weathered	6	0
334. Siltstone, medium-light-gray, thin and irregularly bedded, iron-stained		8
335. Shale, light-olive-gray to medium-gray, weathered	2	0
336. Siltstone, medium-light-gray, thin and irregularly bedded, iron-stained		7
337. Shale, light-olive-gray to medium-gray, weathered, top gradational	4	6
338. Sandstone, medium-light-gray, very fine grained, thick to thin and irregularly bedded, crossbedded, very silty, iron-stained, scattered siltstone lenses up to 3 in thick; fossilized log 1½ ft above base; 5-in-thick silty shale lens 1 ft 2 in below top	7	0
339. Shale, medium-gray, weathered	21	0
340. Shale, dark-brownish-gray, carbonaceous, abundant scattered fossil plant fragments		8
341. Shale, medium-gray, weathered, slightly bentonitic	12	6
342. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, nonresistant	5	6
343. Shale, medium-gray, weathered	1	6
344. Underclay, dark-brownish-gray, carbonaceous, very silty, hard, abundant coal and fossil plant fragments		4
345. Coal, mostly bright, fine to medium cleats, gypsum crystals		6½
346. Underclay, medium-brownish-gray, carbonaceous		3
347. Shale, medium-light-gray, silty, weathered	5	0
348. Siltstone, light-gray, thin-bedded, nonresistant		3
349. Shale, medium-dark-gray, silty, carbonaceous, weathered	1	0
350. Underclay, dark-brownish-gray, very carbonaceous, silty, hard, abundant fossil plant fragments		11
351. Shale, medium-gray, sandy, silty, top gradational		6
352. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded to massive, crossbedded, silty, thin-bedded and very silty in basal 2 in; scattered shale and siltstone lenses up to 6 in thick, pyrite nodules up to inch diameter, solution cavities	28	0
353. Shale, medium-dark-gray, very silty, weathered	10	0
354. Siltstone, medium-light-gray, sandy, nonresistant		5
355. Shale, medium-light-gray, silty, sandy, contains scattered siltstone and sandstone lenses up to 2 in thick	2	10
356. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty	1	2
357. Shale, medium-gray, weathered	1	9
358. Sandstone, medium-light-gray, very fine grained, thin-bedded, very silty, nonresistant		5
359. Shale, medium-gray, bentonitic, weathered	3	0
360. Sandstone, light-olive-gray, very fine grained, thin and irregularly bedded, very silty, coal lenses up to ½ in thick	7	2
361. Sandstone, very fine grained, very silty, dark and light mineral grains, scattered carbonaceous fragments, pyrite nodules up to ⅛ inch in diameter	4	0
362. Shale, light-olive-gray, silty, slightly bentonitic, slightly carbonaceous	2	0
363. Sandstone, medium-light-gray, very fine grained, thick and irregularly bedded, very silty, finely micaceous	1	3
364. Underclay, light-olive-gray to medium-gray, very silty		6
365. Shale, light-gray, very fine grained sandstone interbeds; silty	1	6
366. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, crossbedded, very silty	2	5

		Thickness	
		Ft	in
367.	Shale, light-olive-gray, silty, weathered		8
368.	Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, scattered fossil plant fragments		8
369.	Shale, medium-gray, slightly bentonitic, weathered	6	0
370.	Sandstone, medium-light-gray, very fine to fine-grained, thick to thin and irregularly bedded, crossbedded, slightly silty, dark and light mineral grains, base appears to truncate units 368 and 369, lens-shaped (wedges from 20 to 4 ft)	26	5
371.	Shale, medium-gray to dark-brownish-gray, slightly bentonitic, slightly carbonaceous, weathered	14	0
372.	Sandstone, medium-light-gray, very fine to fine-grained, thick to thin and irregularly bedded, very silty, iron iron stains	2	4
373.	Shale, light-olive-gray, silty, slightly bentonitic	11	0
374.	Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded, silty, pyrite nodules up to ¼ inch in diameter	2	7
375.	Shale, light-olive-gray, silty, weathered	5	6
376.	Limestone, medium-light-gray, finely crystalline, sandy, lens-shaped, brittle	1	7
377.	Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to massive, crossbedded, dark and light mineral grains, solution cavities	2	5
378.	Shale, medium-gray to light-olive-gray, weathered	2	0
379.	Siltstone, medium-gray, thin and irregularly bedded, weathered		7
380.	Shale, medium-gray to light-olive-gray		11
381.	Underclay, dark-grayish-brown, silty, scattered coal lenses up to 1 in thick		10
382.	Shale, medium-gray to light-olive-gray, scattered siltstone lenses up to 2 in thick	6	0
383.	Shale, light-olive-gray, slightly silty, slightly bentonitic, thin to thick-bedded, few solution cavities	4	7
384.	Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded, very silty, pyrite nodules up to ½ inch in diameter	1	7
385.	Shale, light-olive-gray, slightly bentonitic	5	6
386.	Shale, dark-brownish-gray, carbonaceous, weathered, slightly bentonitic	2	0
387.	Underclay, dark-brownish-gray, very silty, very carbonaceous, locally scattered fossil plant fragments	1	3
388.	Shale, medium-gray to light-olive-gray, weathered, top gradational	7	6
389.	Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, silty, dark and light mineral grains	4	0
390.	Shale, medium-gray, slightly bentonitic		8
391.	Underclay, light-brownish-gray, weathered		4
392.	Coal, mostly bright, abundant sulfur stains and gypsum crystals, appears to be truncated by unit 393		1½
393.	Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, carbonaceous, scattered fossil roots		9
394.	Shale, medium-light-gray, silty, weathered, slightly bentonitic, top gradational	6	0
395.	Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, silty, pyrite nodules up to ¼ inch in diameter	3	5
396.	Shale, medium-light-gray, silty		5
397.	Sandstone, light-gray, very fine to fine-grained, thin and irregularly bedded, silty	1	6
398.	Shale, medium-gray, weathered		6
399.	Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded, crossbedded, silty, calcareous, iron-stained, pyrite nodules up to 2 inches in diameter, solution cavities	7	6
400.	Shale, medium-gray to light-olive-gray, silty, slightly bentonitic, scattered carbonaceous lenses up to 2 in thick	14	0
401.	Siltstone, medium-light-gray, thin and irregularly bedded, sandy, iron-stained	1	8
402.	Shale, medium-gray, weathered	7	6
403.	Sandstone, very fine to fine-grained, thin and irregularly bedded, silty	3	6
404.	Shale, light-olive-gray to medium-gray, silty, scattered silty lenses up to 2 in thick	8	0
405.	Sandstone, medium-light-gray, very fine grained, nonresistant	1	0
406.	Shale, light-olive-gray to medium-gray, silty	8	0
407.	Sandstone, medium-light-gray, very fine grained, silty, iron-stained	1	0
408.	Shale, medium-gray to light-olive-gray, weathered	13	0
409.	Sandstone, medium-light-gray, very fine to fine-grained, thin to thick and irregularly bedded, crossbedded, silty, calcareous, iron-stained	2	0
410.	Shale, light-olive-gray to medium-gray, slightly bentonitic, weathered	11	0
411.	Shale, medium-light-gray, slightly carbonaceous, weathered	1	0
412.	Shale, light-olive-gray to gray, weathered	2	3
413.	Sandstone, medium-light-gray, very fine to fine-grained, thick to thin and irregularly bedded	1	5
414.	Shale, medium-gray, weathered		2
415.	Underclay, dark-brownish-gray, silty, abundant fossil plant fragments, carbonaceous		6
416.	Coal, weathered		3½
417.	Shale, medium-brownish-gray, carbonaceous		5

	Thickness	
	Ft	in
418. Sandstone, medium-light-gray, very fine grained, very silty, pyrite nodules up to ½ inch in diameter	1	11
419. Shale, medium-gray, weathered		10
420. Siltstone, medium-gray, weathered, iron-stained		10
421. Sandstone, medium-light-gray, few dark and light mineral grains, iron-stained		10
422. Shale, medium-gray to light-olive-gray, highly weathered	22	0
423. Sandstone, medium-light-gray, very fine grained, very silty, shaly, nonresistant	3	0
424. Shale, medium-light-gray to olive-gray, slightly carbonaceous in top 4 in	1	6
425. Sandstone, medium-light-gray, very fine to fine-grained, thick to thin and irregularly bedded, crossbedded, silty, pyrite nodules up to ¼ inch in diameter	6	6
426. Shale, light-olive-gray to medium-gray, slightly bentonitic, slightly silty, weathered	7	0
427. Siltstone, medium-gray, thin and irregularly bedded, iron-stained, weathered		8
428. Shale, light-olive-gray to medium-gray, slightly silty, slightly bentonitic, weathered	6	6
429. Sandstone, medium-light-gray, very fine grained, thick to thin and irregularly bedded, very silty		11
430. Shale, medium-gray, carbonaceous in upper 6 in	4	6
431. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to massive, crossbedded, pyrite nodules up to ½ in thick, abundant solution cavities	4	7
432. Shale, light-olive-gray, slightly bentonitic, highly weathered	13	0
433. Sandstone, medium-light-gray, very fine to fine-grained, few dark and light mineral grains, pyrite nodules up to ¼ in thick	2	3
434. Shale, medium-gray, weathered	6	7
435. Sandstone, light-gray, very fine grained, thick to thin and irregularly bedded, silty, pyrite nodules up to ⅛ inch in diameter	2	4
436. Shale, light-olive-gray to medium-gray, weathered	1	8
437. Underclay, dark-brownish-gray, silty, carbonaceous	1	1
438. Shale, light-olive-gray, few scattered carbonaceous lenses up to 2 in thick, weathered	7	0
439. Sandstone, medium-light-gray, fine-grained, few medium-sized grains, thin-bedded, crossbedded, dark and light mineral grains, pyrite nodules up to ¼ inch in diameter	7	0
440. Shale, medium-gray, weathered	1	0
441. Sandstone, very light gray to white, fine to medium-grained, thin- to thick-bedded, crossbedded, dark and light mineral grains, pyrite nodules up to ½ inch in diameter	12	0
442. Shale, light-olive-gray to light-gray, highly weathered	15	0
443. Sandstone, very light gray, fine-grained, thin- to thick-bedded, scattered carbonaceous fragments, pyrite nodules up to ¼ inch in diameter	4	0
444. Shale, medium-gray to light-olive-gray	1	0
445. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, crossbedded, upper 3 in calcareous and very resistant	18	0
446. Shale, medium-gray, weathered	6	6
447. Underclay, dark-brownish-gray, silty, carbonaceous, abundant coal lenses up to ¼ in thick, scattered fossil plant fragments, weathered		11
448. Shale, very silty, carbonaceous, abundant fossil plant fragments		7
449. Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, very silty, calcareous	1	1
450. Shale, medium-gray, silty, scattered siltstone lenses up to ½ in thick	2	10
451. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to massive, silty, dark and light mineral grains, 6 inches in diameter fossilized log 2 in above base, scattered fossil plant material	9	0
452. Shale, medium-gray to light-olive-gray, very silty, very weathered	5	0
453. Underclay, medium-gray, slightly silty, abundant fossil plant material		4
454. Coal, mostly bright, weathered		4
455. Shale, medium-gray, fairly fissile, weathered		5
456. Sandstone, medium-light-gray, very fine to fine-grained, thin to thick and irregularly bedded, scattered carbonaceous material, finely micaceous	2	0
457. Shale, medium-gray to light-olive-gray, fairly fissile, weathered	2	2
458. Sandstone, very light-gray, very fine to fine-grained, thick and irregularly bedded, silty, pyrite nodules up to ⅛ inch in diameter	1	7
459. Shale, medium-gray to light-olive-gray, fairly fissile, carbonaceous in top 2 ft, top gradational	5	6
460. Underclay, dark-grayish-brown, carbonaceous, abundant fossil plant material	1	0
461. Sandstone, medium-light-gray, very fine to fine-grained, thick-bedded to massive, crossbedded, pyrite nodules up to ⅛ inch in diameter	1	3
462. Shale, dark-brownish-gray, very carbonaceous, abundant fossil plant material, weathered	1	7
463. Shale, medium-gray to light-olive-gray, weathered	4	8
464. Sandstone, medium-light-gray, fine-grained, thick-bedded to massive, slightly silty, finely micaceous	1	10

	Thickness	
	Ft	in
465. Shale, medium-gray to light-olive-gray, slightly silty, weathered	1	6
466. Shale, medium-gray to light-purplish-gray, gypsum crystals	1	1
467. Underclay, dark-grayish-brown to black, scattered fossil root and plant fragments		3
468. Shale, dark-brownish-gray to dark-olive-gray, carbonaceous		10
469. Shale, light-olive-gray, very bentonitic		4
470. Gypsum, crystalline, massive		½
471. Shale, dark-brownish-gray, carbonaceous, slightly bentonitic, weathered		10
472. Shale, dark- grayish-brown, bentontic, weathered		8
473. Shale, medium-gray to light-olive-gray, fairly fissile, weathered	6	0
474. Underclay, dark-brownish-gray, very carbonaceous, abundant coal lenses up to ¼ in thick, abundant fossil plant material, weathered	1	9
475. Coal, mostly bright, weathered		8
476. Underclay, dark-brownish-gray, very carbonaceous, gypsum crystals, abundant coal lenses up to ¼ in thick, top gradational	1	7
477. Shale, medium-gray to light- olive-gray, fairly fissile, weathered, slightly carbonaceous in top 3 ft	12	6
478. Sandstone, very light gray, very fine to fine-grained, thick to thin and irregularly bedded, crossbedded, silty	8	6
479. Shale, medium-gray, weathered; 8-in-thick dark-gray lens 1 ft below top	9	8
480. Sandstone, medium-gray, very fine to fine-grained, thick to thin and irregularly bedded, dark and light minerals, iron-stained	3	0
481. Shale, medium-gray, weathered	1	0
482. Sandstone, medium-light-gray, very fine to fine-grained, dark and light mineral grains, silty, pyrite nodules up to ¼ inch in diameter	1	6
483. Shale, medium-gray, highly weathered	1	0
484. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded, crossbedded, dark and light mineral grains, silty, scattered shale lenses up to 8 in thick: iron-stained in top 10 ft	35	0
485. Shale, light-olive-gray, weathered		9
486. Sandstone, medium-gray, very fine to fine-grained, thick and irregularly bedded, few dark and light mineral grains	1	2
487. Shale, medium-gray to light-olive-gray, silty, sandy, scattered siltstone lenses up to 8 in thick; weathered; very silty in upper 2 ft	11	0
Total measured thickness of main body of Mesaverde Formation	1,726	0
White sandstone member:		
488. Sandstone, medium-light-gray, very fine to fine-grained, thick and irregularly bedded, silty, iron-stained	2	0
489. Sandstone, very light gray to white, very fine to medium-grained, thick-bedded to massive, crossbedded, dark and light mineral grains, scattered carbonaceous material, solution cavities, pyrite nodules from 1 to 3 inches in diameter, abundant pyrite-filled joints, abundant crossbeds, abundant shale lenses up to 10 in thick in basal 5 ft; 7-in medium-gray shale lens 25 ft above base; 2-ft medium-gray shale lens 223 ft above base; 2-ft medium-gray shale lens 235 ft above base; medium grained in upper half of unit	324	0
490. Shale, medium-light-gray, weathered	6	0
491. Sandstone, very light gray to white, very fine to medium-grained, nonresistant	6	0
492. Shale, medium-dark-gray, weathered	3	2
493. Sandstone, light-gray to white, very fine to medium-grained	5	0
Total measured thickness of white sandstone member	346	2
Total measured thickness of Mesaverde Formation	2,072	2
Meeteetse Formation:		
494. Shale, medium-dark-gray, scattered sandstone lenses up to 1 in thick, highly weathered	10	6
495. Sandstone, medium-light-gray, fine to medium-grained, thin- to thick-bedded; scattered siltstone lenses up to 1 in thick	7	6
496. Shale, medium-gray, highly weathered	10	6
497. Sandstone, medium-light-gray, very fine grained, nonresistant	4	0
498. Shale, medium-light- to medium-dark-gray, highly weathered	6	6
499. Sandstone, medium-gray, very fine grained, silty, weathered	2	0
500. Shale, medium-gray, weathered	5	0
501. Sandstone, light-gray, very fine grained, thin- to thick-bedded, crossbedded, iron-stained; 1-ft-thick medium-gray shale lens 2½ ft above base; shaly sandstone lens 16 ft above base; mostly medium-gray in upper 2 ft	31	0
502. Shale, medium-light-gray, silty, includes light-gray sandstone lens up to 2 ft thick, 3 ft below top, wedges out laterally	16	0
503. Sandstone, medium-light-gray to gray, medium- to fine-grained, thin- to thick-bedded, dark and light mineral grains, solution cavities, scattered pyrite nodules up to ½ inch in diameter	15	0
504. Shale, medium-gray, weathered	2	0
505. Sandstone, very light gray, very fine to fine-grained, thin and irregularly bedded, silty, top gradational	3	0
506. Shale, medium-brownish-gray, weathered	11	0
507. Sandstone, medium-light-gray, fine-grained, crossbedded, silty, light mineral grains, iron-stained		10

	Thickness	
	Ft	in
508. Shale, medium-dark-gray, weathered	5	6
509. Sandstone, very fine grained, thin and irregularly bedded, very silty, scattered medium-gray shale lens up to ½ in thick	10	0
510. Shale, medium-gray to light-olive-gray, weathered	10	0
511. Sandstone, very light gray to white, fine-grained, thin- to thick-bedded, crossbedded, dark and light mineral grains, moderately quartzose	27	0
512. Shale, medium-gray, weathered	1	6
513. Shale, very dark gray to black, very carbonaceous, bentonitic, abundant fossil plant material, scattered coal lenses up to ¼ in thick	1	0
514. Shale, medium-dark-gray	1	6
515. Sandstone, medium-gray, very fine to fine-grained, thick to thin and irregularly bedded, scattered carbonaceous material, iron-stained	5	4
516. Shale, medium-gray to light-olive-gray; 1-ft-thick sandstone lens 14 ft above base, carbonaceous in top 2 ft; weathered	12	0
517. Sandstone, very light gray, very fine grained, thick and irregularly bedded, crossbedded, dark and light mineral grains	5	6
518. Shale, medium-light-gray, very fine grained, sandstone lens 4 ft above base, weathered	10	0
519. Sandstone, medium-light-gray to very light gray, very fine grained, thick-bedded to massive, silty, dark and light mineral grains	9	0
520. Underclay, medium-olive-gray, silty, weathered		2
521. Shale, dark-gray to black, very carbonaceous, scattered fossil plant material	1	1
522. Shale, medium-gray to light-olive-gray, silty, weathered	12	0
523. Underclay, dark-brownish-gray, silty, carbonaceous, abundant fossil plant fragments and rootlets		11
524. Coal, bright-to-dull, gypsum crystals, medium cleats, highly weathered		9½
525. Sandstone, medium-light-gray, very fine to fine-grained, silty, basal part contains abundant carbonaceous shale fragments, weathered, nonresistant	9	0
526. Shale, olive-gray, slightly bentonitic; 8-in-thick purple-gray lenses 5 ft and 9 ft above base; highly weathered	10	0
527. Underclay, light- to medium-olive-gray, very silty, slightly bentonitic, hard, abundant fossil plant fragments and rootlets	4	0
528. Shale, dark-purplish-gray, carbonaceous, poor fissility, highly weathered	2	4
529. Underclay, dark-purplish-gray to black, very carbonaceous, silty	1	3
530. Coal, fine to medium cleats, highly weathered, gypsum crystals		10½
531. Underclay, medium-grayish-brown, carbonaceous, gypsum crystals, abundant fossil plant material and rootlets	1	10
532. Shale, light-olive-gray, slightly bentonitic, weathered	2	1
533. Sandstone, medium-light- to light-gray, very fine to fine-grained, silty, friable, nonresistant, scattered calcareous nodules up to 3 inches in diameter	11	6
534. Underclay, light-purplish-gray, very silty, very hard, scattered coal fragments up to ¼ inch in diameter		10
535. Siltstone, light-gray to light-olive-gray, scattered fossil plant fragments, weathered, nonresistant	5	0
536. Underclay, light-purplish-gray, abundant slickensides		9
537. Shale, dark-purplish-gray to black, very carbonaceous, silty, gypsum crystals, abundant fossil plant fragments, nonresistant	2	11
538. Shale, medium-gray to light-olive-gray, slightly bentonitic	6	6
539. Sandstone, medium-gray to light-olive-gray, very fine to fine-grained, silty, iron-stained	5	6
540. Sandstone, medium-light-gray, very fine grained, silty, abundant fossil plant fragments and rootlets, weathered, nonresistant, friable	2	9
541. Shale, light-olive-gray to medium-dark-gray, weathered, fairly fissile	2	3
542. Shale, dark-purplish-gray to black, silty, gypsum crystals		8
543. Siltstone, light-olive-gray, sandy, slightly carbonaceous, hard	2	6
544. Shale, carbonaceous, gypsum crystals, weathered, poorly fissile	4	0
545. Shale, light-olive-gray to medium-gray, fairly fissile, weathered	4	3
546. Sandstone, light-olive-gray to medium-gray, fine-grained, silty, weathered; 1-in-thick coal lens 1 in above base	1	5
547. Sandstone, light-purplish-gray, very fine grained, silty, carbonaceous, abundant fossil plant fragments, abundant coal chips, weathered	5	0
548. Shale, light-olive-gray, very weathered	3	3
549. Shale, medium-gray to very light olive gray, medium-grained, abundant dark mineral grains, few green and red mineral grains, very calcareous; 2-ft-thick iron-stained zone 2 ft above base; friable	9	6
550. Sandstone, very light gray, fine- to medium-grained, crossbedded, dark and light mineral grains, pyrite nodules up to ¼ inch in diameter; scattered calcareous concretions up to 2 ft thick; slump bedding, very friable, nonresistant, iron-stained	14	8
551. Shale, light-olive-gray, sandy, bentonitic, weathered	2	6

	Thickness	
	Ft	in
552. Underclay, light-purplish-gray, very silty, scattered fossil plant fragments and rootlets		3
553. Shale, very dark gray to black, carbonaceous, abundant fossil plant fragments		4
554. Shale, light-olive-gray, bentonitic, weathered	3	6
555. Shale, medium-gray, silty		9
556. Siltstone, light-olive-gray, thin and irregularly bedded, weathered	3	6
557. Shale, medium-gray to light-olive-gray, weathered	5	0
558. Sandstone, medium-light-gray, very fine grained, very calcareous, silty, dark and light mineral grains, iron-stained	3	6
559. Shale, light-olive-gray, highly weathered	4	8
560. Sandstone, very light gray, very fine grained, thick to thin and irregularly bedded, crossbedded, very silty, very calcareous, slightly carbonaceous, abundant fossil plant fragments, iron-stained in top 2 ft	5	6
561. Shale, light-olive-gray, very silty, weathered	6	3
562. Underclay, medium-purplish-gray, very silty, slightly bentonitic, abundant fossil plant fragments and rootlets, weathered	4	7
563. Shale, dark-brownish-gray, very carbonaceous, silty, fairly fissile, abundant fossil plant fragments, abundant coal fragments, hard	2	2
564. Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty, basal contact sharp and irregular, appears to fill channel into unit 563	3	6
565. Shale, olive-gray to dark purplish-gray, very carbonaceous, resistant, top 6 in very silty	2	0
566. Sandstone, very light gray, very silty, highly weathered	1	9
567. Shale, light-olive-gray, slightly bentonitic, weathered	2	0
568. Shale, medium-purplish-gray, bentonitic, highly weathered	1	9
569. Shale, light-olive-gray to medium-gray, bentonitic, highly weathered	3	2
570. Sandstone, very light gray, weathered, friable	1	8
571. Underclay, dark-brownish-gray, slightly carbonaceous, silty, abundant fossil rootlets, scattered coal fragments		10
572. Coal, mostly dull, highly weathered, fine to medium cleats, abundant gypsum crystals in cleats, abundant sulfur stains		4
573. Underclay, light-brownish-gray, very sandy, slightly carbonaceous		2
574. Coal, weathered		1
575. Sandstone, very light gray to white, very fine grained, very silty, friable to nonresistant, basal 4 in highly weathered, coal chips	20	0
576. Shale, light-olive-gray, bentonitic, very silty, weathered, hard	3	7
577. Underclay, medium-light-gray, very sandy, very silty, abundant fossil plant fragments, hard	1	8
578. Coal, mainly dull, medium cleats, weathered		3½
579. Sandstone, light-gray, very fine grained, very silty, calcareous concretions in basal 2 ft; 6-in medium-gray shale lens 6 ft above base; nonresistant	10	6
580. Underclay, light-olive-gray, silty, sandy		7
581. Shale, very dark gray to black, very carbonaceous, very silty	2	1
582. Siltstone, light-olive-gray, abundant fossil plant fragments, weathered	3	5
583. Underclay, medium-brownish-gray, very silty, poorly fissile	1	5
584. Coal, resin blebs, fine cleats, gypsum crystals, abundant sulfur stains		6½
585. Shale, medium-gray to light-olive-gray, basal zone very carbonaceous, silty, bentonitic	1	6
586. Underclay, olive-gray, slightly silty, bentonitic		5
587. Coal, mostly bright, very silty		1½
588. Sandstone, light-olive-gray to gray, very silty, bentonitic, nonresistant	3	3
589. Shale, medium-olive-gray, bentonitic	3	9
590. Sandstone, light-gray, very fine grained, very silty, iron-stained	1	4
591. Shale, light-olive-gray, bentonitic, weathered	5	0
592. Coal, highly weathered		½
593. Sandstone, medium-light-gray, very fine grained, very silty, weathered	3	4
594. Underclay, light-olive-gray, sandy, silty, weathered	3	0
595. Coal, weathered		1½
596. Sandstone, medium-light-gray, very fine to fine-grained, very silty, calcareous, nonresistant, iron-stained in top 2 ft	16	0
597. Shale, light-olive-gray, very silty	8	5
598. Underclay, light-olive-gray to very dark gray, very silty, hard	1	2
599. Shale, dark-gray to black, carbonaceous, poorly fissile	1	11
600. Shale, light-olive-gray to medium-gray, very silty	6	6
601. Underclay, dark-brownish-gray, carbonaceous, silty, abundant fossil plant fragments, gypsum crystals	2	0
602. Shale, very dark gray to black, very carbonaceous, poorly fissile	2	1
603. Shale, light-olive-gray, silty, weathered	5	0
604. Sandstone, very fine to fine-grained, thin and irregularly bedded, very silty, carbonaceous, very calcareous, abundant carbonaceous fragments	4	6
605. Shale, light-olive-gray, sandy, silty, weathered	4	9
606. Shale, dark-brownish-gray to dark-purplish-brown, silty, carbonaceous,		

		Thickness	
		Ft	in
	fairly fissile, abundant fossil plant fragments, hard		11
607.	Shale, medium-gray to light-olive-gray, silty, scattered siltstone lenses	14	6
608.	Shale, medium-light-gray, silty, sandy, slightly carbonaceous, weathered	5	6
609.	Shale, dark-brownish-gray, very silty, carbonaceous, fairly fissile, weathered, abundant fossil plant fragments	1	11
610.	Shale, medium-gray to light-olive-gray, weathered	6	2
611.	Underclay, dark-purplish-brown to black, carbonaceous, scattered coal lenses up to ¼ in thick	1	2
612.	Shale, very dark gray to black, very carbonaceous, sulfur-stains		11
613.	Shale, light-olive-gray to medium-gray, silty, bentonitic, weathered	4	10
614.	Sandstone, medium-light-gray, very fine grained, thick-bedded to massive, silty, very calcareous, iron-stained	2	3
615.	Shale, light-olive-gray, slightly bentonitic, weathered	5	3
616.	Shale, dark-purplish-gray, very carbonaceous, weathered		3
617.	Shale, medium-gray, silty	1	10
618.	Sandstone, medium-light-gray, very fine grained, abundant fossil plant rootlets, iron-stained	2	0
619.	Siltstone, light-olive-gray, sandy, bentonitic	1	11
620.	Shale, medium-purplish-gray, silty, weathered	4	8
621.	Sandstone, medium-gray, very fine grained, thin and irregularly bedded, very silty, very calcareous, slightly carbonaceous	2	9
622.	Shale, light-olive-gray, slightly bentonitic, weathered	8	0
623.	Underclay, medium-gray, silty, abundant fossil plant rootlets, hard	1	5
624.	Coal, mostly bright, very fine cleats		2½
625.	Underclay, medium-purplish-gray, very silty, carbonaceous, coal fragments	1	5
626.	Coal, weathered, very impure		1½
627.	Shale, medium-greenish-gray, very bentonitic, weathered	12	0
628.	Sandstone, medium-light-gray, very fine grained, silty, nonresistant	2	6
629.	Shale, olive-gray to medium-dark-gray, silty, bentonitic, weathered	32	0
630.	Underclay, olive-gray, silty, abundant fossil plant rootlets	1	2
631.	Shale, medium-grayish-brown, carbonaceous lenses up to ¼ in thick		7
632.	Coal, weathered		½
633.	Sandstone, light-olive-gray, very weathered, friable	5	0
634.	Shale, light-olive-gray, sandy, silty, weathered	11	0
635.	Shale, medium-purplish-gray, highly weathered, slightly bentonitic	4	0
636.	Shale, dark-purplish-gray to black, weathered		10
637.	Shale, light-brownish-gray, slightly carbonaceous, fairly fissile, abundant fossil plant fragments		8
638.	Shale, light-greenish-gray, weathered		9
639.	Sandstone, very fine grained, very silty, nonresistant	9	6
640.	Shale, light-olive-gray, weathered		11
641.	Shale, light-brownish-gray, slightly carbonaceous, scattered fossil plant fragments		8
642.	Underclay, medium-gray to light-olive-gray, very silty, fossil plant rootlets	3	0
643.	Shale, dark-gray to black, very carbonaceous, fairly fissile	1	6
644.	Shale, olive-gray, slightly carbonaceous, very silty top 6 in, weathered	4	5
645.	Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, calcareous, silty, abundant sulfur stains and gypsum crystals; 4-in-thick carbonaceous shale zone 6 ft 4 in above base increasing to 1 ft thick along outcrop; 2-ft medium-gray shale 1 ft below top; resistant, iron staining	18	0
646.	Sandstone, very light gray, very fine grained, thin-bedded to massive, very silty, few solution cavities	5	9
647.	Underclay, medium-brownish-gray, carbonaceous, silty, gypsum crystals, fossil plant rootlets		3
648.	Coal, impure, fine to medium cleats, resin blebs, gypsum crystals, abundant sulfur stains, few shale lenses up to ¼ in thick	1	6
649.	Siltstone, medium-gray to light-olive-gray, thin and irregularly bedded	1	0
650.	Shale, light-olive-gray, slightly bentonitic	4	3
651.	Sandstone, light-gray, very fine grained, thin- to thick-bedded, iron-stained	3	8
652.	Shale, medium-gray to light-olive gray, silty	5	0
653.	Underclay, dark-brownish-gray, silty, carbonaceous, abundant gypsum crystals, abundant fossil plant fragments	1	2
654.	Sandstone, light-gray, very fine grained, dark mineral grains, thin and irregularly bedded	1	5
655.	Shale, medium-greenish-gray, weathered	2	0
656.	Shale, medium-brownish-gray, fairly fissile, carbonaceous, abundant fossil plant fragments		4
657.	Sandstone, light-gray, fine-grained, thin- to thick-bedded, crossbedded, silty, basal 1 in abundant shale fragments; 4-in lens of medium-coarse-grained material 1 ft above base; slumpbedding, iron stains	42	0
658.	Shale, medium-gray, gypsum crystals, weathered	5	0
659.	Shale, dark-brownish-gray, fairly fissile, gypsum crystals, scattered fossil plant fragments	2	0
660.	Coal, dull, impure		7

		Thickness	
		Ft	in
661.	Shale, dark-gray to black, silty, carbonaceous	1	0
662.	Sandstone, medium-gray, very fine grained, very silty, nonresistant	2	7
663.	Shale, medium-gray to light-olive-gray, weathered	1	0
664.	Sandstone, medium-gray, very fine grained, very silty, nonresistant	4	0
665.	Shale, medium-brownish-gray, carbonaceous, weathered	3	6
666.	Underclay, dark-brownish-gray, silty, carbonaceous material, gypsum crystals, fossil plant fragments and rootlets, resistant	6	0
667.	Coal, dull, impure, finely cleated, weathered, abundant sulfur stains	1	5
668.	Shale, dark-purplish-gray to black, gypsum crystals	2	11
669.	Shale, light-olive-gray to medium-gray, slightly bentonitic	5	6
670.	Sandstone, very fine to fine-grained, thick and irregularly bedded, very silty, calcareous, basal contact gradational	14	6
671.	Shale, light-olive-gray, few siltstone lenses up to 6 in thick, weathered	20	0
672.	Sandstone, light-gray, weathered	2	0
673.	Shale, dark-brownish-gray, carbonaceous, abundant fossil plant fragments	1	6
674.	Coal, dull, impure, weathered, resin blebs, gypsum crystals		9
675.	Sandstone, medium-gray, very fine grained, very silty, raindrop imprints	3	0
676.	Shale, light-olive-gray, very weathered		11
677.	Underclay, dark-brownish-gray, silty, carbonaceous, scattered coal lenses up to 1/8 in thick, hard	1	5
678.	Sandstone, very light gray, very fine grained, thin- to thick-bedded, crossbedded, very silty, scattered siltstone lenses up to 1 in thick	6	0
679.	Shale, dark-brownish-gray, fairly fissile, very carbonaceous, weathered	1	4
680.	Sandstone, light-gray, fine- to medium-grained, thin- to thick-bedded, calcareous, weathered, iron-stained	12	0
681.	Shale, medium-gray to light-olive-gray, silty	20	0
682.	Sandstone, very light gray, very fine grained, silty	2	0
683.	Underclay, medium-brownish-gray, carbonaceous, scattered fossil plant fragments	1	2
684.	Coal, dull, very impure, bony, resin blebs, gypsum crystals	1	0
685.	Underclay, dark-brownish-gray, silty, carbonaceous, scattered fossil plant fragments		5
686.	Shale, medium-gray to light-olive-gray	5	6
687.	Shale, dark-brownish-gray to dark-gray, carbonaceous, weathered		10
688.	Shale, light-olive-gray, silty, bentonitic, weathered, carbonaceous in top 3 ft	6	3
689.	Shale, dark-brownish-gray, silty, weathered, scattered fossil plant fragments	2	2
690.	Sandstone, very fine grained, thin to thick and irregularly bedded, very silty, nonresistant	3	3
691.	Shale, light-olive-gray, bentonitic, weathered	2	0
692.	Underclay, light-olive-gray, very weathered		6
693.	Shale, dark-gray to black, carbonaceous		9
694.	Shale, light-olive-gray to medium-gray, silty, weathered	6	0
695.	Sandstone, very fine grained, very silty, very weathered		4
696.	Shale, medium-gray, weathered	1	6
697.	Shale, medium-brownish-gray, carbonaceous, scattered fossil plant fragments		8
698.	Shale, medium-gray, weathered	3	0
699.	Shale, dark-brownish-gray, carbonaceous, scattered fossil plant fragments		8
700.	Shale, black, carbonaceous		7
	Total measured thickness of Meeteetse Formation	932	3

Lance Formation:

		Thickness	
		Ft	in
701.	Sandstone, light-gray, fine-grained, silty, ironstone lag deposits up to 4 in thick in basal 10 ft; solution cavities, scattered shale lenses up to 2 ft thick	83	0
702.	Shale, medium-dark-gray to brownish-gray, weathered	7	6
703.	Underclay, dark-brownish-gray, carbonaceous, abundant fossil plant fragments		7
704.	Shale, dark-gray to black, silty, weathered	4	8
705.	Shale, light-olive-gray to medium-gray, bentonitic, weathered	23	0
706.	Sandstone, light-gray, very fine to fine-grained, thin to thick and irregularly bedded, crossbedded, very silty, friable	8	8
707.	Shale, medium-gray to light-olive-gray, slightly bentonitic, weathered	14	0
708.	Shale, dark-purplish-gray, poor fissility, bright coal lens 3 in thick wedging out along outcrop, 2½ ft above base; scattered fossil plant fragments, slightly bentonitic, weathered	4	6
709.	Shale, light-olive-gray to medium-gray, weathered, slightly bentonitic	11	0
710.	Shale, dark-purplish-gray, carbonaceous		5
711.	Siltstone, medium-gray, iron-stained	1	2
712.	Sandstone, medium-light-gray, very fine grained, thin- to thick-bedded, lens-shaped, very silty	2	0
713.	Shale, medium-gray, very silty		4
714.	Sandstone, very fine to fine-grained, thin to thick and irregularly bedded, silty	1	2
715.	Shale,light-olive-graytomedium-purplish-brown, slightly carbonaceous, weathered	1	0
716.	Sandstone, very fine grained, thin and irregularly bedded, very silty, wedges out laterally, scattered fossil plant fragments	1	3

		Thickness	
		Ft	in
	Total measured thickness of Lance Formation	164	3
	Unconformity		
	Paleocene:		
	Fort Union Formation:		
717.	Underclay, dark-brownish-gray, silty, carbonaceous, scattered fossil plant rootlets and fragments, hard	2	6
718.	Shale, light-olive-gray to medium-gray, slightly bentonitic	5	0
719.	Sandstone, light-gray to very light gray, fine-grained, dark and light mineral grains, thick-bedded to massive, crossbedded, conglomeratic zones up to 1 ft thick, subangular to angular feldspathic pebbles, shale zones up to 2 in thick, solution cavities	44	0
720.	Shale, olive-gray to medium-gray, carbonaceous	6	0
721.	Sandstone, medium-brownish-gray to medium-light-gray, fine- to coarse-grained, iron-stained, small solution cavities up to 1 inch in diameter in basal 2½ ft; angular to subangular pebbles up to ¾ inch in diameter, shale chips, sandstone fragments, quartz and feldspar grains in a few conglomerate zones	5	7
722.	Shale, medium-dark-gray to dark-olive-gray, slightly carboniferous, weathered	10	6
723.	Shale, medium-dark-gray, weathered, carbonaceous		8
724.	Sandstone, light-brownish-gray, fine- to medium-grained, thick and irregular bedding, lenticular, conglomerate lens up to 2 in thick, angular to subangular clasts up to ¼ inch in diameter	2	6
725.	Shale, medium-gray, highly weathered	2	0
726.	Conglomerate, medium-gray to light-brownish-gray, fine- to coarse-grained matrix, pebbles up to 2 inches in diameter, subrounded to subangular, composed of quartz, pink feldspar, and agate, thick-bedded to massive, sandstone clasts, iron-stained	16	0
727.	Sandstone, medium-light-gray, medium-grained, conglomerate lenses up to 6 in thick with clasts up to ¼ inch in diameter, friable, highly weathered	8	0
728.	Shale, medium-dark-gray, carbonaceous, highly weathered	1	7
729.	Sandstone, medium-light-gray, medium-grained, crossbedded, conglomerate lenses up to 6 in thick, clasts up to ¼ inch in diameter, friable, highly weathered	4	6
730.	Conglomerate, medium-brownish-gray, coarse-grained matrix, quartz, feldspar, sandstone, agate, and quartzite pebbles and cobbles up to 3 inches in diameter, subangular to subrounded, few well-rounded cobbles	15	0
731.	Sandstone, light-gray, medium-grained, thick and irregularly bedded, crossbedded, ripple marks, conglomerate lenses up to 6 in thick, subangular clasts up to ¼ inch in diameter, very silty in basal 4 ft; 2-ft-thick medium-gray shale lens 15 ft above base	35	0
732.	Shale, medium-dark-gray to olive-gray, weathered	5	6
733.	Sandstone, medium-light-gray, fine-grained, thin-bedded, lens-shaped	1	6
734.	Shale, medium-gray to light-olive-gray, highly weathered	2	0
735.	Sandstone, very fine to fine-grained, thin and irregularly bedded, dark and light mineral grains, silty, noncalcareous, iron-stained in top 1 ft	2	0
736.	Shale, light-olive-gray, bentonitic, weathered	2	0
737.	Sandstone, very fine grained, silty, weathered, fossil plants and rootlets	2	4
738.	Shale, light-olive-gray to medium-gray, silty, scattered silt lenses		11
739.	Sandstone, dark-purplish-brown, highly iron stained, very fine to fine-grained, thick-bedded, ferruginous iron cement	5	0
740.	Siltstone, light-olive-gray, bentonitic	4	3
741.	Shale, medium-gray, silty, weathered	4	2
742.	Siltstone, medium-gray, bentonitic, sandy	26	6
743.	Sandstone, light-gray, very fine grained, very silty	1	6
744.	Shale, light-olive-gray, silty, bentonitic, weathered	14	6
745.	Sandstone, medium-light-gray, very fine grained, thin-bedded, crossbedded, silty	1	0
746.	Shale, dark-gray to olive-gray, highly carbonaceous	9	0
747.	Sandstone, light gray, very fine grained, thin and irregularly bedded, very silty, weathered	1	2
748.	Shale, light-olive-gray, slightly bentonitic, weathered	9	0
749.	Sandstone, light-gray, very fine to fine-grained, thin- to thick-bedded, iron-stained, weathered	6	0
750.	Shale, medium-gray, bentonitic, sandy, silty, weathered	6	0
751.	Sandstone, medium-light-gray, fine-grained, thick-bedded, silty	20	0
752.	Shale, medium-gray, highly weathered, silty	15	6
753.	Sandstone, light-gray, fine-grained, massive, silty, scattered shale lenses up to 1 ft thick in top 5 ft	18	0
754.	Shale, medium-light-gray, silty, slightly bentonitic, weathered	16	0
755.	Sandstone, light-gray, very fine to fine-grained, thick-bedded to massive, silty, calcareous	5	0
756.	Shale, medium-dark-gray, bentonitic, highly weathered	2	7

	Thickness	
	Ft	in
757. Sandstone, medium-light-gray, very fine to fine-grained, few medium grains, thick and irregularly bedded	1	4
758. Shale, light-brownish-gray, weathered	3	6
759. Sandstone, very fine grained, thin and irregularly bedded, very silty, nonresistant, iron-stained	2	6
760. Sandstone, light-gray, fine to medium-grained, few coarse grains, thick and irregularly bedded to massive, crossbedded, few solution cavities, iron-stained	32	0
761. Shale, medium-gray, highly weathered	4	0
762. Sandstone, light-gray, very fine to medium-grained, weathered	2	4
763. Shale, medium-light-gray, bentonitic, highly weathered	5	0
764. Sandstone, light-gray, very fine to medium-grained, weathered	1	0
765. Shale, medium-gray, silty, abundant silty sandstone lenses up to 8 in thick	15	0
766. Sandstone, very light gray, fine-grained, thick and irregularly bedded	1	2
767. Shale, medium-gray, slightly bentonitic, highly weathered	1	5
768. Sandstone, very light gray, fine-grained, few coarse grains, thick and irregularly bedded	3	0
769. Shale, medium-gray, slightly bentonitic, highly weathered	2	1
770. Sandstone, very light gray, fine-grained, few coarse grains, thick and irregularly bedded, crossbedded	2	3
771. Shale, medium-gray, very silty, weathered	9	0
772. Sandstone, medium- to coarse-grained, thin to thick and irregularly bedded, dark mineral grains, very iron stained	1	7
773. Shale, medium-gray, silty, weathered	12	0
774. Sandstone, very light gray, medium-grained, few coarse grains, thick and irregularly bedded, iron-stained	6	2
775. Sandstone, light-gray to dark-brownish-gray, conglomeratic, thick and irregularly bedded, angular to subangular, mostly feldspathic clasts up to ½ inch in diameter	17	0
776. Sandstone, light-gray, fine-grained, thin to thick and irregularly bedded, iron-stained, scattered shale lenses up to 1 ft thick, wedges out	30	0
777. Shale, medium-gray, weathered	5	6
778. Sandstone, light-gray, fine-grained, silty		8
779. Shale, medium-gray; 6-in-thick medium-light-gray sandstone lens, weathered		11
780. Sandstone, medium-light-gray, fine-grained, silty, weathered	5	0
781. Shale, medium-gray to light-olive-gray, slightly bentonitic, weathered	6	0
782. Sandstone, medium-light-gray, very fine grained, thin and irregularly bedded, very silty, iron-stained		9
783. Shale, medium-gray, sandy, silty, highly weathered	4	0
784. Sandstone, medium-gray, very fine grained, thin- to thick-bedded, silty, iron-stained	2	6
785. Shale, medium-gray, silty, weathered	16	0
786. Sandstone, light-gray, fine- to medium-grained, thin- to thick-bedded, crossbedded, dark mineral grains, iron-stained	5	0
787. Shale, medium-gray, silty, weathered	1	6
788. Sandstone, light-gray, fine- to medium-grained, thick-bedded, crossbedded, iron stains, scattered conglomerate lenses up to 6 in thick with clasts 1 inch in diameter	26	0
789. Shale, medium-gray, bentonitic, weathered	16	0
790. Sandstone, medium-light-gray, fine- to medium-grained, thick-bedded, iron-stained	3	0
791. Shale, medium-gray, silty, bentonitic, weathered	27	0
792. Sandstone, very fine to fine-grained, silty, shaly, highly iron stained, weathered	1	2
793. Sandstone, very light gray, very fine to fine-grained, thick and irregularly bedded, iron stains	10	6
794. Shale, medium-gray, slightly bentonitic, weathered	4	6
795. Sandstone, medium-light-gray, fine-grained, thin- to thick-bedded, dark mineral grains, weathered	2	0
796. Shale, medium-gray, weathered	1	6
797. Sandstone, very light gray, fine-grained, thick and irregularly bedded, iron stains, weathered	2	11
798. Shale, medium-gray, weathered	6	0
799. Sandstone, light-gray, fine-grained, dark mineral grains, thick and irregularly bedded, noncalcareous, pyrite nodules up to 1 inch in diameter	6	1
800. Shale, medium-gray, silty, bentonitic, weathered	1	6
801. Sandstone, medium-light-gray, fine- to medium-grained, thick-bedded to massive, crossbedded, noncalcareous, pyrite nodules up to 1 inch in diameter	7	6
802. Shale, medium-gray, silty, weathered	1	6
803. Sandstone, very light gray, fine- to medium-grained, thin- to thick-bedded		11
804. Shale, medium-gray, weathered, slightly bentonitic	10	6
805. Sandstone, medium-light-gray, very fine to fine-grained, thin and irregularly bedded, iron-stained	1	9
806. Shale, medium-gray, weathered	1	0
807. Sandstone, medium-light-gray, medium-grained, thick-bedded, high-angle crossbedding; iron-stained, conglomerate wedge up to 2 ft thick with subangular to angular clasts of quartz, feldspar, sandstone fragments, and quartzite up to ½ inch in diameter; 3½-in-thick		

	Thickness	
	Ft	in
ironstone layer in conglomerate wedge 5 ft below top of unit	19	0
808. Sandstone, light-gray, fine- to medium-grained, crossbedded, weathered, iron stains	15	0
Total measured thickness of Fort Union Formation	703	9
Unconformity		
Eocene:		
Indian Meadows Formation:		
809. Shale, light-olive-gray, highly weathered	9	6
810. Conglomerate, dark-brownish-gray, coarse-grained, pebbles and cobbles, subrounded up to 2 inches in diameter, agate matrix, clasts of petrified wood	35	0
811. Sandstone, medium-light-gray, fine- to medium-grained, thin-bedded, crossbedded, silty	11	0
812. Siltstone, light-olive-gray, thin and irregularly bedded, weathered	1	10
813. Shale, medium-gray, weathered	1	6
814. Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty	4	0
815. Shale, medium-gray, weathered		10
816. Sandstone, light-gray, very fine grained, thin and irregularly bedded, very silty	3	0
817. Shale, medium-gray, silty, weathered	4	0
818. Sandstone, light-gray, very fine grained, thin and irregularly bedded, silty, slightly iron stained	1	6
819. Shale, medium-gray, bentonitic, weathered	6	0
820. Sandstone, light-gray, fine-grained, dark mineral grains, thin and irregularly bedded	3	6
821. Shale, medium-gray to light-olive-gray, bentonitic, weathered	8	0
822. Sandstone, light-gray, fine-grained, dark mineral grains, thin- to thick-bedded, iron-stained	18	0
823. Shale, light-olive-gray to medium-gray, silty, scattered sandstone lenses up to 1½ ft thick, bentonitic	20	0
824. Sandstone, very light gray, thick-bedded, very silty	1	0
825. Shale, medium-gray to light-olive-gray, very silty, bentonitic	4	0
826. Sandstone, light-gray, fine- to medium-gray, dark mineral grains, nonresistant	3	6
827. Siltstone, olive-gray, bentonitic, weathered	6	6
828. Shale, dark-olive-gray to black, carbonaceous, poorly fissile, scattered coal lenses up to ¼ in thick	3	6
829. Siltstone, light-olive-gray, bentonitic	15+	
Section truncated by sharp fold and fault		
Total measured thickness of Indian Meadows Formation	161	2+

Measured section 21: Mesaverde Formation through Lance Formation

Location: Eagle Point Quadrangle, Wyoming (7.5 min)

Start: SW–NW–SW sec. 31, T. 6 N., R. 1 E. Presented from oldest to youngest

End: NW–SE–SE sec. 31, T. 6 N., R. 1 E

Described by: J.F. Windolph, Jr.

Strike 160°, Dip 20° NE.

Section starts at top of approximately 200 ft of the white sandstone member

	Thickness	
Upper Cretaceous:	Ft	in
Mesaverde Formation:		
White sandstone member	200+	
Meeteetse Formation:		
1. Shale, medium-gray, sandy, thin-bedded sandstone interbeds	6	0
2. Shale, medium-gray to light-brownish-gray, few sandstone lenses, thin-bedded, fissle, fossil plant fragments and roots in top of unit	4	5
3. Coal, impure		2
4. Sandstone, white to light-gray, massive, crossbedded, coal fragments, fine- to medium-grained, silty	21	0
5. Shale, medium-gray to light-brown, upper 6 in carbonaceous	3	5
6. Coal, slightly impure in basal 4 in, bright, fusain	1	0
7. Shale, medium-gray, thin- and poorly bedded	1	0
8. Sandstone, light-gray, very fine grained to fine-grained, massive, carbonaceous matter in upper 1 ft	13	0
9. Shale, medium-gray with a few light-brownish-gray carbonaceous zones 6 in thick	9	0
10. Shale, carbonaceous, light-brownish-gray, fossil roots	2	3
11. Coal, bright, weathered, fragile		9
12. Shale, light-brownish-gray to dark-gray, poorly bedded	2	5
13. Shale, medium-gray, bentonitic; 1-ft-thick sandstone at top of unit	5	0
14. Shale, medium-gray	4	5
15. Shale, light-brownish-gray, carbonaceous	1	0
16. Shale, medium-gray, thick-bedded	5	0
17. Shale, light-brownish-gray, fossil roots		5
18. Coal, bright to impure, basal 2 in bony	1	4
19. Shale, medium-gray, bentonitic	9	0
20. Shale, grayish-brown, nonbedded, fossil roots		5
21. Coal, bright		3
22. Shale, medium-gray, thin and evenly bedded, changes to light-brownish-gray upward	5	0
23. Shale, light-brownish-gray		5
24. Coal, bright		7
25. Sandstone, white to medium-light-gray, very fine to fine-grained, massive, friable, dark mineral grains	25	0
26. Shale, poorly bedded, fossil roots	2	8
27. Coal, impure, sandy lenses		1
28. Sandstone, white, very fine to fine-grained, massive, crossbedded, calcar-		

	Thickness Ft	 in
eous lens 1 ft thick; channel filling sandstone wedges out to the east and south	14	0
29. Shale, light-brownish-gray, fossil roots	3	0
30. Coal, impure		5
31. Shale, medium-dark-gray, carbonaceous, bentonitic		7
32. Shale, light-brownish-gray, carbonaceous, bentonitic	2	0
33. Shale, grayish-brown	1	0
34. Sandstone, medium-light-gray, dark mineral grains, bentonitic	2	6
35. Shale, light-brownish-gray, carbonaceous		6
36. Shale, medium-gray, bentonitic	14	0
37. Shale, light-brownish-gray, carbonaceous	1	3
38. Sandstone, light-gray, very fine to fine-grained, dark mineral grains, bentonitic, shaly	6	0
39. Shale, light-brownish-gray		6
40. Sandstone, light-gray, very fine to fine-grained, dark mineral grains, shaly, bentonitic, calcareous nodules	11	0
41. Shale, light-brownish-gray, coaly		1
42. Sandstone, medium-light-gray to medium-gray, very fine to fine-grained, silty, massive, friable	9	0
43. Shale, medium-gray, bentonitic		5
44. Coal, bright to dull, fusain, basal ½ ft shaly and bony; 1-in-thick granular tonstein 1 ft 3 in above base; 1¼-in-thick brown granular tonstein 8 in below top of unit (Woodruff and Winchester, 1912, pl. L, no. 53)	3	3
45. Shale, medium-gray, thin and evenly bedded	1	6
46. Shale, medium-gray to medium-light-gray, sandy, silty, bentonitic, interbedded with sandstone and thin, carbonaceous shale	10	0
47. Sandstone, light-gray, fine-grained, dark mineral grains, bentonitic	15	0
48. Shale, carbonaceous, light-brownish-gray	1	0
49. Sandstone, medium-light-gray to light-gray, silty, shaly, calcareous nodules up to 1 inch in diameter, bentonitic, becomes medium-grained and darker upward	30	0
50. Shale, medium-dark-gray, carbonaceous, coaly, thin-bedded at base, nonbedded at top	1	6
51. Shale, medium-gray, medium-dark-gray and light-greenish-gray, bentonitic with sandstone lenses; 5-ft-thick sandy zone 10 ft above base; 6-in-thick dark-gray, carbonaceous shale zone 17 ft above base; 7-ft-thick medium-grained, light-gray, sandy zone 25 ft above base	45	0
52. Sandstone, light-gray, bentonitic, very fine to fine-grained, thin-bedded	11	0
53. Shale, medium-gray, silty, bentonitic	16	5
54. Underclay, medium-gray, silty, hard, fossil roots		9
55. Coal, bright to impure		6
56. Shale, medium-dark-gray, carbonaceous	1	2
57. Shale, medium-gray, silty, thin and evenly bedded	5	0
58. Sandstone, medium-gray, thin-bedded, very fine grained, silty, contorted bedding	5	5
59. Shale, medium-gray, silty	2	0
60. Coal, bright		4
61. Shale, medium-gray, silty, thin-bedded	9	5
62. Shale, medium-dark-gray, fossil roots		7
63. Coal, bright to impure		4
64. Shale, medium-gray, thin and evenly bedded, light-brownish-gray, fossil roots	1	3
65. Sandstone, medium-light-gray, very fine grained, silty, thick-bedded, fossil roots	4	5
66. Shale, light-brownish-gray, carbonaceous	1	2
67. Shale, black, coaly, impure, very fissile		3
68. Shale, medium-gray, thin-bedded	4	2
69. Shale, medium-dark-gray to dark-gray, resin blebs	2	2
70. Shale, medium-greenish-gray to olive-green, bentonitic	7	0
71. Sandstone, medium-gray, very fine to fine-grained, thin-bedded, contorted bedding, calcareous, few shaly zones locally fill a massive channel; 4-ft-thick shaly zone 10 ft above base	17	0
72. Shale, brownish-gray	1	0
73. Shale, medium-gray, thin-bedded, silty	6	0
74. Sandstone, medium-gray, thin-bedded, very fine grained, silty	1	0
75. Shale, medium-gray, thin-bedded, silty	10	0
76. Sandstone, light-gray, silty, massive	16	0
77. Shale, medium-gray, thin-bedded, bentonitic	7	0
78. Shale, grayish-brown, thin-bedded, fossil roots	2	0
79. Coal, bright to dull, fusain, contains 1½-in-thick granular tonstein at top	1	8
80. Shale; 4-in-thick light-brownish-gray to medium-gray sandstone lens 1½ ft below top	4	0
81. Sandstone, medium-gray to medium-light-gray, calcareous lenses up to 2 ft thick, very fine to fine-grained, thick-bedded, massive	5	0
82. Shale, medium-gray, thin-bedded	3	0
83. Shale, light-brownish-gray, carbonaceous, thin-bedded, fossil roots	1	0
84. Coal, bright to dull, fusain; 2-in-thick granular tonstein at top	2	4
85. Shale, light-brownish-gray, carbonaceous, thin-bedded		2
86. Sandstone, medium-gray, very fine grained, thin-bedded	1	0
87. Shale, medium-gray; 1-in-thick calcareous layers, light-greenish-gray; thin bedded at top	9	0

	Thickness	
	Ft	in
88. Sandstone, medium-gray to medium-light-gray, very fine to fine-grained, calcareous lenses 3 ft thick, irregular, thick-bedded	5	5
89. Shale, medium-gray, silty, sandy	5	0
90. Sandstone, medium-gray, very fine to fine-grained, thin-bedded	15	0
91. Shale, light-brownish-gray, carbonaceous	1	4
92. Shale, medium-gray, bentonitic	2	9
93. Sandstone, medium-gray, very fine grained, thin-bedded		4
94. Shale, medium-gray, thin-bedded, bentonitic	6	0
95. Shale, light-brownish-gray, carbonaceous		3
96. Shale, light- to medium-light-gray, bentonitic, gypsum crystals	3	0
97. Shale, light-brownish-gray to brown, very carbonaceous, resin blebs	1	4
98. Coal, impure, canneloid, shaly		7
99. Shale, medium-gray, bentonitic	16	0
100. Shale, medium-gray, silty, sandy	5	0
101. Sandstone, medium-gray, very fine grained, thin-bedded		8
102. Shale, medium-gray, silty, thin-bedded	2	0
103. Shale, light-brownish-gray, fossil roots		6
104. Coal, bright, resin blebs in base, fusain, locally 1-in-thick tonstein 7 in below top, occasional petrified wood at base	1–3	
105. Shale, light-brownish-gray, carbonaceous		5
106. Sandstone, medium-light-gray, very fine grained, silty, shaly, dark mineral grains bentonitic	25	0
107. Shale, medium-gray to light-olive-gray, bentonitic	9	0
108. Sandstone, medium-gray to medium-light-gray, very fine to fine-grained, silty, massive	24	0
109. Shale, medium-gray, silty, sandy, bentonitic, contains 6-in-thick carbonaceous shale 1½ ft above base of unit, ironstones	8	0
110. Sandstone, medium-light-gray, very fine to fine-grained, dark mineral grains, bentonitic	10	0
111. Shale, grayish-brown, carbonaceous, thin-bedded		2
112. Shale, light-greenish-gray, thin and evenly bedded, calcareous	10	0
113. Shale, light-brownish-gray, carbonaceous, fossil roots		9
114. Coal, bright		3
115. Shale, medium-gray, thin-bedded, silty, sandy, with sandstone lenses	2	4
116. Shale, light-brownish-gray, carbonaceous, thin-bedded, fossil roots		3
117. Coal, bright to dull, impure, bony, resin blebs		8
118. Shale, dark-gray, nonbedded, very carbonaceous		8
119. Shale, light-greenish-gray, silty, thin and evenly bedded	1	6
120. Shale, light-brownish-gray, carbonaceous		4
121. Sandstone, medium- to medium-light-gray, calcareous nodules up to 3 ft in diameter, very fine grained to fine-grained, few lenses of light-greenish-gray shale in basal 1 ft, silty	25	0
122. Shale, medium-gray to light-greenish-gray	1	1
123. Shale, light-brownish-gray, carbonaceous, fossil roots		2
124. Coal, bright to dull, resin blebs		8
125. Shale, light-brownish-gray to medium-dark-gray		4
126. Siltstone, medium-gray, very fine grained, silty, sandy	3	5
127. Shale, light-brownish-gray, carbonaceous, fossil roots		8
128. Coal, impure		3
129. Shale, light-brownish-gray, thin-bedded, carbonaceous		7
130. Shale, light-greenish-gray to medium-gray, thin-bedded, silty	1	3
131. Sandstone, medium-light-gray, very fine to fine-grained, silty, thin-bedded, shaly	11	0
132. Shale, light-greenish-gray, medium-gray, calcareous	17	0
133. Sandstone, medium-light-gray to medium-gray, very fine to fine-grained, silty, thin-bedded, shaly	12	0
134. Shale, light-greenish-gray to medium-gray, silty, thin and evenly bedded	3	0
135. Sandstone, medium-light-gray, very fine to fine-grained, silty, massive, calcareous nodules; lens-shaped bedding up to 3 ft thick, dark mineral grains, crossbedded	60	0
136. Shale, light-greenish-gray to medium-gray, calcareous, thin and evenly bedded	17	0
137. Shale, light-brownish-gray, carbonaceous	3	2
138. Shale, medium-gray, silty, sandy, thin and evenly bedded	5	0
139. Sandstone, medium-gray, thin-bedded, very fine grained, calcareous	1	0
140. Shale, medium-gray, thin and evenly bedded, silty	4	0
141. Shale, medium-gray, thin and evenly bedded, silty		7
142. Coal, bright		8
143. Shale, light-greenish-gray to medium-gray, thin and evenly bedded	1	2
144. Limestone, medium-gray, silty, brittle, weathers brown	1	0
145. Shale, medium-gray, medium-dark-gray, and light-greenish-gray, few carbonaceous zones	12	0
146. Siltstone, calcareous, sandy, shaly, thin and evenly bedded	5	0
147. Shale, light-greenish-gray to medium-gray, silty	3	0

	Thickness	
	Ft	in
148. Shale, light-brownish-gray, carbonaceous, fossil roots		9
149. Coal, weathered, impure		2½
150. Shale, dark-brown, carbonaceous, interbedded volcanic ash and tonstein, coal fragments, thin-bedded	1	0
151. Sandstone, medium-light-gray, very fine to fine-grained, massive, crossbedded, calcareous nodules up to 3 ft in diameter	6	5
152. Shale, light-greenish-gray to medium-gray, thin and evenly bedded	5	0
153. Shale, light-brownish-gray, carbonaceous, fossil roots	1	5
154. Coal, bright, resin blebs, fusain	1	2
155. Shale, light-brownish-gray, carbonaceous		9
156. Shale, light-greenish-gray, silty, calcareous, thin and evenly bedded	1	6
157. Sandstone, medium-light-gray to white, massive, friable, very fine to fine-grained, silty, calcareous nodules up to 3 ft in diameter	30	0
158. Shale, light-greenish-gray, calcareous, thin and evenly bedded	7	0
159. Shale, light-brownish-gray, thin and evenly bedded, carbonaceous	1	0
160. Shale, medium-gray, thin and evenly bedded, silty	2	6
161. Sandstone, medium-light-gray to light-gray, very fine to fine-grained, massive, few calcareous lenses, crossbedded, few ironstone pebble conglomerate zones, friable	70	0
162. Shale, light-greenish-gray to medium-gray, silty, thin and evenly bedded, calcareous	1	6
163. Shale, light-brownish-gray, carbonaceous		9
164. Shale, light-greenish-gray to medium-gray, silty, thin and evenly bedded, calcareous	2	4
165. Shale, light-brownish-gray, fissile, carbonaceous	1	0
166. Shale, light-greenish-gray, silty, thin and evenly bedded, calcareous	5	0
167. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded		9
168. Shale, light-brownish-gray to dark-brown, very carbonaceous, coaly, resin blebs	2	1
169. Shale, light-greenish-gray to medium-gray, silty, calcareous	5	0
170. Shale, light-brownish-gray, carbonaceous, fossil roots		6
171. Coal, impure, shaly, channels in upper surface filled by unit 172, locally up to 1 ft thick		4
Total measured thickness of Meeteetse Formation	944	11
Unconformity		
Lance Formation:		
172. Sandstone, light-yellow-brown, massive, contorted bedding, high-angle cross-bedding, pebble conglomerate containing pyrite nodules and fossil bone. Base undulates; chaotic deposition 130 ft above base, friable and silty, with lenses of heavy minerals; 200 ft above base, sandstone is white to light gray, thick bedded, massive; 5-ft medium-gray shale lens at 225 ft above base; 35 ft of medium-gray shale 245 ft above base	545	0
Total measured thickness of Lance Formation	545	0

Measured section 22: Frontier Formation and Cody Shale

Location: Blue Holes Quadrangle, Wyoming (7.5 min)
Start: SW–SW–NE sec. 5, T. 5 N, R. 5 W. Presented from oldest to youngest
End: SE–SW–NE sec. 5, T. 5 N, R. 5 W.
Described by: J.F. Windolph, Jr.
Strike 110°, Dip 45° NE.

	Thickness	
Upper Cretaceous:		
Frontier Formation:	Ft	in
1. Shale, dark-gray to black, bentonitic, carbonaceous, few coal lenses	2	0
2. Sandstone, medium-light-gray, very fine to fine-grained, crossbedded, thin-bedded	1	3
3. Shale (underclay), light-brownish-gray, sandy, thin-bedded, fossil roots		6
4. Coal, bright, faulted, sheared	2	0
5. Sandstone, medium-light-gray, very fine to fine-grained, lens-shaped bed		4
6. Shale, light-brownish-gray, thin-bedded; few 2-in-thick silty sandstone beds in upper 1 ft	3	0
7. Sandstone, medium-light-gray, very fine to fine-grained, silty, few light-brownish-gray shale laminae	5	8
8. Shale, light-brownish-gray, thin-bedded, carbonaceous, fossil root prints		8
Base of Wilderness coal bed		
9. Coal, bright to dull, fusain, cleats 40° at 90° and 140° at 45° SW., gypsum crystals in cleats, basal 2 in shaly	2–4	
Top of Wilderness coal bed		
10. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, carbonaceous lenses, crossbedding, layer of black, rounded quartz pebbles at top of bed, pebbles up to 1½ inches in diameter	1	9
11. Shale, medium-gray, thin and evenly bedded, calcareous; 2-in-thick medium-grained sandstone in upper 3 in, silty	4	0
12. Coal, bright		4
13. Sandstone, medium-light-gray, very fine to fiZne-grained, massive	8	0

	Thickness	
	Ft	in
14. Shale, medium-gray to medium-dark-gray, thin-bedded, silty, slightly carbonaceous	30	0
15. Shale, light-greenish-gray, soft, nonbedded	1	2
16. Shale, medium-gray to medium-dark-gray, silty, slightly carbonaceous	2	0
17. Sandstone, medium-gray, very fine grained, silty, thin-bedded		6
18. Shale, medium-gray to light-brownish-gray, silty, thin-bedded, slightly carbonaceous	24	0
19. Sandstone, medium-gray to medium-light-gray, thin-bedded, very fine to fine-grained, few fissile carbonaceous shale layers up to 2 in thick, crossbedded	8	0
20. Shale, dark-brown, carbonaceous, sandy	2	8
21. Sandstone, medium-gray, few carbonaceous shale layers, very fine grained, silty, crossbedded, thin-bedded, carbonaceous and coal laminae at top of unit	49	5
22. Shale, black to dark-brown, coaly		2
23. Sandstone, medium-light-gray, fine- to medium-grained, ferruginous, thick-bedded	1	8
24. Shale, light-greenish-gray, bentonitic	2	0
25. Shale, dark-brownish-gray to medium-dark-gray, carbonaceous	2	5
26. Shale, light-greenish-gray, carbonaceous, sandy	1	7
27. Sandstone, medium-gray to medium-light-gray, very fine grained, silty, carbonaceous laminae; medium-gray shale, coal fragments, crossbedded, thin bedded	11	0
28. Shale, medium-gray to light-brownish-gray, thin-bedded, few zones of light-greenish-gray to white limestone nodules 5 ft and 10 ft above base	20	0
29. Sandstone, medium-light-gray to light-gray, fine- to medium-grained, dark mineral grains, massive to thin-bedded; crossbedded, shale chips, sandstone chips, coal fragments in rubble zone, shale lenses in basal 7 ft; upper 10 ft thin bedded	30	0
30. Shale, medium-gray to light-brownish-gray, thin- bedded	9	0
31. Shale, medium-dark-gray to dark-gray, very carbonaceous, slightly coaly	1	0
32. Shale, medium-gray, thin-bedded	3	5
33. Sandstone, medium-light-gray, medium- to fine-grained, thin-bedded	3	0
34. Shale, medium-gray to medium-dark-gray, carbonaceous	16	0
Total measured thickness of Frontier Formation	151	7

Cody Shale:

	Thickness	
	Ft	in
35. Limestone, medium-gray, silty		8
36. Shale, medium-gray, thin-bedded, bentonitic, gypsum	6	0
37. Ironstone, very dark gray, silty, carbonaceous		4
38. Bentonite, medium-gray	7	0
39. Shale, medium-dark-gray	50+	—
Total measured thickness of Cody Shale	74+	

Unconformity

Lower Eocene (Basal conglomerate):

Indian Meadows Formation:

Measured section 23: Frontier Formation and Indian Meadows Formation

Location: Blue Holes Quadrangle, Wyoming (7.5 min)
Start: SW–SW–SE sec. 31, T. 6 N., R. 5 W. Presented from oldest to youngest
End: SW–SE, sec. 31, T. 6 N., R. 5 W.
Described by: J.F. Windolph, Jr.
Strike 140°, Dip 40° NE.

Upper Cretaceous:

Frontier Formation:

	Thickness	
	Ft	in
1. Gouge zone, fault plane; strike 155°, dip 25° N.E.	6	0
2. Shale, olive-brown to dark-brownish-gray, bentonitic, silty, carbonaceous, poorly bedded to nonbedded	40	0
3. Sandstone, medium-gray, very fine to fine-grained, silty, thin-bedded, bentonitic, coal lenses up to 2 in thick at base, medium-gray, carbonaceous shale laminations in the upper 2 ft	15	0
4. Sandstone, medium-light-gray, very fine grained, silty, forms resistant ledge, crossbedded, massive, thin-bedded, slightly bentonitic, few shale lenses; 6-in-thick, thin-bedded, resistant sandstone ledge at top of unit	40	0
5. Shale, light-greenish-gray to olive-gray, bentonitic	4	0
6. Shale, light-brownish-gray, carbonaceous, nonbedded		4
7. Siltstone and tonstein; Siltstone—light-olive-brown, hard to brittle; tonstein—light-brown, bentonitic, gypsum crystals, fossil plant fragments	1	6
8. Shale, light-brownish-gray, thin-bedded, carbonaceous		4
9. Shale, light-greenish-gray, nonbedded, bentonitic		7
10. Shale, dark-brownish-gray, thin-bedded, carbonaceous, silty and sandy at top	1	3
11. Sandstone, light-gray, thin-bedded, small-scale crossbedding, very fine grained, silty, carbonaceous laminae, shale interbeds	2	4
12. Shale (underclay), light-brownish-gray, very silty, very sandy, fossil roots; 4-in-thick sand lenses; dark-gray carbonaceous shale 1 ft 2 in below top, high volcanic ash particle content	2	5

Base of Wilderness coal bed

13. Coal, basal 5 in dull, shaly, few 1/4-in shale partings in basal 6 in; 1 1/4-in-

	Thickness Ft	in
thick shale parting 8 in below top of unit	1	7
Top of Wilderness coal bed		
14. Shale, medium-gray, nonbedded, bentonitic	3	3
15. Shale, medium-dark-gray, carbonaceous, thin-bedded	5	0
16. Sandstone, medium-gray, very fine to fine-grained, shale chips in lens-shaped beds	1	0
17. Shale, medium-gray, thin and evenly bedded	2	0
18. Sandstone, medium-light-gray, very fine grained, silty, crossbedded, upper 1 ft medium-grained	2	5
19. Shale, medium-gray, carbonaceous, thin-bedded	3	4
20. Sandstone, medium-gray, very fine grained, silty, crossbedded, thin-bedded	2	8
21. Ironstone band, black, sandy, hard		4
22. Shale, medium-gray, thin-bedded to nonbedded at top	2	6
23. Shale, dark-gray to black, very carbonaceous, thin-bedded, coaly		5
24. Sandstone, medium-light-gray to light-gray, massive, friable, dark mineral grains, very fine to fine-grained, silty	18	0
25. Sandstone, medium-gray to medium-light-gray, very fine to medium-grained, lenses of shale chips, coal chips, carbonaceous shale, with underclay, pyrite nodules, and fossil plant fragments, light-brownish-gray	3	4
26. Shale, medium-dark-gray, very carbonaceous		9
27. Sandstone, medium-light-gray to medium-gray, very fine to fine-grained, thin- to thick-bedded, calcareous nodules, friable	5	0
28. Shale, medium-gray, thin and evenly bedded	1	2
29. Shale, light-brownish-gray, carbonaceous, very silty to sandy		9
30. Shale, medium-gray, thin and evenly bedded	1	2
31. Sandstone, medium-gray to medium-light-gray, very fine to fine-grained upward, silty, thin-bedded	4	0
32. Shale, medium-dark-gray, carbonaceous		6
33. Sandstone, medium-light-gray, very fine grained, thin-bedded		7
Total measured thickness of Frontier Formation	173	6
Unconformity		
Lower Eocene:		
Indian Meadows Formation:		
34. Conglomerate, medium-gray, cobbles, boulders, rounded metamorphics and Paleozoic rocks, ±1 ft in diameter, arkosic	17	0
35. Sandstone, very coarse grained lens-shaped bed	4	0
36. Limestone, white, silty and sandy at base		4
37. Shale, medium-gray to light-brownish-gray, carbonaceous, thin-bedded	17	0
38. Limestone, light-greenish-gray, nodules 1 ft in diameter, interbedded with greenish-gray shale	5	0
39. Shale, light-olive-gray, poorly bedded	17	0
40. Conglomerate, cobbles and boulders of Paleozoic and metamorphic rocks, medium-gray, arkosic, granular	50+	
Total measured thickness of Indian Meadows Formation	111	4

Measured section 24: Indian Meadows Formation and Frontier Formation Thrust Slice

Location: Bain Draw Quadrangle, Wyoming (7.5 min)

Start: NE–NW–NW sec. 20, T. 41 N., R. 105 W; trending eastward down ridge. Presented from oldest to youngest

End: NE–NE–NW sec. 20, T. 41 N., R. 105 W.

Described by: J.F. Windolph, Jr.

Strike 100°, Dip 40° NE.

	Thickness Ft	in
Lower Eocene:		
Indian Meadows Formation:		
1. Boulder conglomerate, limestone boulders, metamorphic boulders, up to 3 ft in diameter, granular sandstone, matrix arkosic, potassium feldspars, few lenses of red and green shale, parallel bedding, chaotic distribution of boulder sizes, crossbedded, indurated	16	0
Total measured Indian Meadows Formation	16	0
Thrust fault—Places Frontier Formation on top of Indian Meadows Formation		
Upper Cretaceous:		
Frontier Formation:		
2. Shale, light-greenish-gray to medium-gray, very bentonitic, poorly bedded	10	0
3. Shale, medium-gray, thin and evenly bedded, slightly bentonitic, includes 1-in-thick thin-bedded, light-greenish-gray sandstone 53 ft above base, slightly carbonaceous at top, upper 10 ft very silty	68	0
4. Sandstone, medium-gray to light-greenish-gray, very fine grained, thin-bedded, very silty, shaly at base, massive, friable, very fine to fine-grained at top, fossil roots	64	0
5. Coal, weathered, basal 3 in impure sandy lenses		6
6. Sandstone, medium-gray, very fine to fine-grained, thick-bedded, pyrite nodules	1	5
7. Shale, medium-gray, thin-bedded, silty and sandy	4	0

	Thickness Ft	Thickness in
8. Shale, brownish-gray, thin-bedded, carbonaceous, fossil plant and coal fragments		4
9. Shale, light-greenish-gray, bentonitic		3
10. Shale, medium-dark-gray, poorly bedded		9
11. Shale, light-greenish-gray, calcareous, silty, ferruginous		8
12. Shale, medium-gray to medium-dark-gray, carbonaceous in basal 2 ft, poorly bedded	12	0
13. Sandstone, medium-light-gray, very fine grained, silty, thin- to thick-bedded, crossbedded	2	8
14. Shale, light-greenish-gray, silty, calcareous, ferruginous	1	7
15. Shale, dark-brownish-gray, carbonaceous, fossil root prints		4
16. Coal, impure		4
17. Sandstone, bentonitic, carbonaceous, abundant gypsum crystals	1	1
18. Shale, bentonitic, light-olive-gray to light-olive-brown, weathered	14	0
19. Shale, light-brownish-gray to medium-dark-gray, carbonaceous, thin-bedded		4
20. Shale, light-greenish-gray to olive-gray, silty	8	8
21. Shale, dark-brownish-gray, thin-bedded, carbonaceous	1	9
22. Sandstone, medium-light-gray, very fine to fine-grained, thin- to thick-bedded	2	5
Base of Wilderness coal bed		
23. Coal, bright to dull, fusain, cleats 35° at 90° and 100° at 55° SW.	1	4
Top of Wilderness coal bed		
24. Shale, light-brownish-gray, carbonaceous, tonstein-volcanic ash bed at base; 1-in-thick volcanic ash bed 2 ft below top	4	0
25. Coal, impure, sandstone interbeds		2
26. Sandstone, white, medium- to coarse-grained, arkosic, abundant dark mineral grains, crossbedded, thin- to thick-bedded, fault zone trending 145° and dipping 70° NE.	22	0
27. Shale, medium-gray to medium-dark-gray, carbonaceous, sandy at base	6	0
28. Sandstone, very fine to fine-grained, shaly, medium-gray to medium-light-gray	2	2
29. Shale, medium-gray, poorly bedded	3	9
30. Sandstone, medium-light-gray to dark-gray, crossbedded, thick-bedded to massive, very fine to fine-grained, shaly zones, few calcareous nodular zones up to 2 ft thick; 4-ft zone of medium-dark-gray shale and carbonaceous sandstone 15 ft above base; 5-ft zone of medium-dark-gray to light-brownish-gray carbonaceous shale 60 ft above base	115	0
Total measured thickness of Frontier Formation	349	6

	Thickness Ft	Thickness in
Cody Shale:		
31. Shale, medium-gray to medium-dark-gray, few thin-bedded sandstone interbeds, approximately 500 ft exposed		

Measured section 25: Mesaverde Formation (Part)

Location: Alkali Butte Quadrangle, Wyoming, (7.5 min)
Start: SE–SE–SW sec. 22, T. 34 N., R. 95 W. Presented from oldest to youngest
End: NW–NW–NW sec. 27, T. 34 N., R. 95 W.
Described by: J.F. Windolph, Jr.
Strike 160°, Dip 30° SW.

	Thickness Ft	Thickness in
Upper Cretaceous:		
Mesaverde Formation:		
1. Sandstone, medium-light-gray, weathered to light-yellow-gray, very fine to fine-grained, silty, thin-bedded to massive, contorted bedding, crossbedded, solution cavities; few carbonaceous laminations, calcareous zones, and pyrite nodules; upper 10 ft light gray, parallel bedded	80	0
2. Underclay, medium-gray, fossil root prints		3
3. Sandstone, medium-light-gray, fine- to medium-grained, carbonaceous fragments		4
4. Shale (underclay), medium-gray, gypsum crystals		1½
5. Shale, light-brown, carbonaceous, thin-bedded, fossil plant and root prints		1
6. Coal, bright		2
7. Shale, carbonaceous, brown, thin-bedded, gypsum crystals, fossil plants	1	0
8. Shale, medium-gray, thin-bedded, gypsum crystals	1	1
9. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded	4	0
10. Shale, medium-gray, thin-bedded	4	0
11. Shale (underclay), medium-gray, thin-bedded, carbonaceous, fossil plant and root prints		9
12. Coal, bright, resin blebs, fragile		6
13. Shale, carbonaceous, light-brownish-gray, thin-bedded, vitrain lenses		6
14. Shale, medium-gray, thin-bedded, few silty beds; upper 10 ft very sandy, with sandstone interbeds	26	0
15. Shale, light-brown, carbonaceous, thin-bedded	1	6
16. Coal, bright, resin blebs		3
17. Shale, medium-gray, thin-bedded, upper 1 ft bentonite	3	0
18. Shale (underclay), light-brown, carbonaceous, thin-bedded, fossil plant and root prints		6
19. Coal, bright		7
20. Shale, light-brown, thin-bedded, carbonaceous, fossil plant impressions		4

	Thickness	
	Ft	in
21. Shale, medium-gray, thin-bedded	4	6
22. Shale, light-brown, thin-bedded, carbonaceous		6
23. Sandstone, medium-light-gray, lenses, contorted bedding	1	0
24. Shale (underclay), light-brown, carbonaceous, thin-bedded, fossil plant and root prints		4
25. Coal, bright, fragile, resin blebs		9
26. Shale, light-brown to medium-gray, bentonitic, gypsum crystals, coal lenses, thin-bedded to nonbedded	3	2
27. Coal, bright to dull		7
28. Shale, medium-gray, thin-bedded to nonbedded, bentonitic, gypsum crystals	2	0
29. Shale, light-brown, thin-bedded, carbonaceous, gypsum crystals, fossil plant and root prints	1	6
Base of Signor coal bed		
30. Coal, bright to dull resin blebs, fusain and 1/2-in tonstein layer 28 in above base	4	0
Top of Signor coal bed		
31. Shale, light-brown to medium-gray, silty, sandy, thin-bedded, carbonaceous	1	10
32. Sandstone, medium-light-gray, very fine grained, silty, fills basal channel in unit 31; parallel bedding; upper 3 ft interbedded with medium-gray shale	17	0
33. Shale, light-brown, thin-bedded, carbonaceous	3	0
34. Sandstone, medium-light-gray, very fine to fine-grained, silty, thin-bedded, crossbedded	32	0
35. Shale, medium-light-gray, thin-bedded, sandstone lenses	10	0
36. Sandstone, medium-light-gray, weathers light-yellowish-gray, very fine to fine-grained, silty, crossbedded at base; upper two-thirds parallel bedded, includes calcareous beds	43	0
37. Sandstone, white to light-gray, fine- to medium-grained, crossbedded, pyrite nodules, abundant burrows in upper 4 in, sulfate efflorescence on surfaces	30	0
38. Shale, light-brownish-gray, thin-bedded, fossil plant prints	2	0
39. Sandstone, light-brown, thin-bedded, fine- to medium-grained, pyrite nodules, burrows	1	0
40. Shale, medium-dark-gray, thin-bedded	1	8
41. Sandstone, white- to light-gray, fine-grained, massive, crossbedded, abundant burrows in upper 1 ft; 2 in of carbonaceous shale 3 ft below top	16	0
42. Shale, light-brown, very silty, sandstone lenses, burrows, poorly bedded, fossil plant prints	3	0
43. Shale, brown, thin-bedded, very carbonaceous, fossil plant prints		6
44. Siltstone, light-brownish-gray, poorly bedded, slightly carbonaceous	1	4
45. Sandstone, white- to light gray, very fine grained, silty, burrows, crossbedded, base fills channel in unit 44	1	0
46. Shale (underclay), light-brown, carbonaceous, very silty, sandy, fossil plant and root prints		1
Base of Beaver coal bed		
47. Coal, bright to dull, fusain bands, gypsum crystals and sulfur stains on cleats, sparse resin blebs, mud-filled fossil roots; cleats 100° at 75° NE. and 10° at 60° SE.	3	6
Top of Beaver coal bed		
48. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, lens-shaped bed		4
49. Shale, medium-gray, thin-bedded	1	8
50. Shale, light-brown, carbonaceous, thin-bedded	1	0
51. Shale, medium-gray, thin-bedded	1	4
52. Sandstone, medium-light-gray, very fine grained, silty		7
53. Shale, medium-gray, thin-bedded		8
54. Sandstone, medium-light-gray to light-yellow-brown, very fine grained, silty, shaly, upper 4 ft very shaly and bentonitic	14	0
55. Shale, light-brown, carbonaceous, thin-bedded, gypsum crystals	2	0
56. Sandstone, light-yellowish-gray, very fine to fine-grained, thin-bedded, contorted bedding	10	0
57. Shale, medium-gray, interbedded siltstone, sandstone, and thin carbonaceous shale beds, upper 3 ft very sandy	10	0
58. Sandstone, white- to light-gray, very fine to fine-grained, massive, thin volcanic ash laminations; upper 1 1/2 ft very calcareous; weathers yellow brown	16	0
59. Sandstone, medium-light-gray, very fine grained, silty, friable (partly covered)	16	0
60. Shale, light-brown, thin-bedded, carbonaceous, fossil plants	1	1
61. Shale, medium-gray, thin-bedded	1	6
62. Shale, light-brownish-gray, thin-bedded, silty, fossil plant and root prints		8
63. Coal, bright to dull, fusain, resin blebs; 1-in-thick tonstein 2 ft above base	3	0
64. Shale, light-brown, carbonaceous, thin-bedded	3	0
65. Shale, medium-gray, silty, thin-bedded	4	0
66. Shale, light-brown, thin-bedded, fossil plant and root prints	2	6
67. Coal, bright		6
68. Sandstone, medium-light-gray, fine- to medium-grained, lens-shaped bed		3
69. Shale, medium-gray, silty, thin-bedded, slightly carbonaceous	4	6
70. Ironstone, black, hard, brittle		6
71. Shale, medium-gray	3	0
72. Ironstone, brown, hard, brittle		6
73. Sandstone, light-gray, fine-grained, partly covered	5	0

	Thickness	
	Ft	in
74. Sandstone, white- to light-gray, arkosic, fine- to medium-grained, thin-bedded to massive, burrowed in upper 1 ft; pyrite nodules, few carbonaceous layers; parallel bedded at top, crossbedded in basal portion	60	0
75. Shale, medium-gray, few 1- to 2-in white sandstone interbeds; basal 3 ft light-brown and slightly carbonaceous	6	0
76. Sandstone, white, fine-grained, top burrowed		6
77. Shale, light-brown, carbonaceous, fossil plant and root prints	1	0
78. Coal, bright to dull, fusain, basal 2 in bony	1	10
79. Sandstone, medium-light-gray, very fine grained, silty, shaly	11	0
80. Shale, light-brown, carbonaceous, thin-bedded	6	0
81. Siltstone, medium-gray, shaly	1	10
82. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded, weathers reddish-brown		6
83. Shale, medium-gray, silty, sandy	1	4
84. Sandstone, brown, fine-grained, thin-bedded, ironstone fills pore spaces in sandstone		5
85. Shale, medium-gray, thin-bedded; brown, sandy, ironstone interbeds; upper 2 ft contains fossil root prints	4	0
86. Shale, brown, carbonaceous, silty, fossil plant and root prints		9
87. Coal, bright		2½
88. Sandstone, light-brown, very fine to fine-grained, coal and carbonaceous laminations	1	2
89. Sandstone, dark-brown, fine- to medium-grained; abundant detrital coal	13	0
90. Sandstone, white- to light-gray, very fine to fine-grained, silty, massive, calcareous; 3-ft-thick contorted beds 15 ft above base	22	0
91. Sandstone, medium-light-gray, very fine grained, partly covered	13	0
92. Shale, light-brownish-gray, carbonaceous, silty, thin-bedded, fossil plant and root prints	4	6
93. Sandstone, medium-light-gray, very fine to fine-grained, thin-bedded		8
94. Shale, medium-gray, thin-bedded	2	6
95. Shale, light-brown, thin-bedded, fossil plant and root prints	1	2
Base of Shipton coal bed		
96. Coal, bright to dull, basal 2 in bony	1	2
97. Tonstein, light-brown to pinkish-gray		1½
98. Shale, light-brown, upper 2 in very carbonaceous		8
99. Tonstein, light-brown to pinkish-gray, fossil plant prints		7
100. Coal, bright to dull, fusain, resin blebs, cleats 65° at vertical and 160° at 40° NE.	4	7
101. Tonstein, light-brown to pinkish-gray, fossil plant prints and flattened volcanic ash particles		½
102. Coal, bright		2½
Top of Shipton coal bed		
103. Shale, very light brown, thin-bedded	2	4
104. Ironstone, brownish-black, very fine grained, sandy, thin-bedded		8
105. Shale, medium-gray, thin-bedded	7	0
106. Ironstone, brownish-black, very fine grained, sandy, thin-bedded	2	0
107. Shale, medium-gray	2	0
108. Sandstone, white- to light-gray, silty, friable	4	0
109. Shale, light-brown, carbonaceous, thin-bedded	1	0
110. Shale, medium-gray, few sandstone and ironstone bands, thin-bedded, very sandy at top	17	0
111. Shale, light-brown, carbonaceous, silty, sandy, thin-bedded	1	6
112. Sandstone, light-yellowish-brown, very fine grained, friable, shaly, includes few ironstone bands	16	0
113. Shale, light-brown, carbonaceous, thin-bedded	1	0
114. Sandstone, light-gray, very fine grained, friable, silty, shaly, few ironstone layers	16	0
115. Sandstone, light-gray, very fine grained, very silty, and shaly, calcareous, resistant calcareous and shale interbeds	54	0
Total measured thickness of Mesaverde Formation	694	6

Measured section 26: Cody Shale through Indian Meadows Formation

Location: Sand Draw Quadrangle, Wyoming (7.5 min)

Start: SW–NW–NW sec. 27, T. 33 N., R. 95 W. Presented from oldest to youngest

End: SE–NW–NW sec. 27, T. 33 N., R. 95 W., Partial section

Described by: J.F. Windolph, Jr., and F.I. Frasse

Strike 110°, Dip 15° NE.

	Thickness	
Upper Cretaceous:	Ft	in
Cody Shale:		
1. Shale, medium-gray, weathered, silty; slightly bentonitic, with a few interbeds of very fine grained sandstone	145	0
2. Sandstone, medium gray, fine-grained, dark and light mineral grains, animal tracks, possible salt casts, coarse ripple marks		4
3. Shale, medium-gray, weathered, silty; slightly bentonitic, with a few interbeds of very fine grained sandstone	20	0
4. Sandstone, medium-gray, fine-grained, very calcic, thin and evenly bedded, animal tracks		6

	Thickness Ft	in
5. Shale, medium-gray to light-grayish-brown, thin-bedded, weathered, silty, slightly bentonitic; contains iron-stained concretions up to 1 ft in diameter; sandstone lens 70 ft above base becomes very silty at top; 4 in of thin and evenly bedded sandstone 40 ft above base	130	0
6. Sandstone, medium-gray to medium-light-olive-gray, very fine grained, silty, dark and light grains, weathered, nonbedded, bentonitic	25	0
7. Shale, medium-gray, silty, bentonitic, a few thin beds but mostly nonbedded	58	0
Total measured thickness of Cody Shale	378	10
Mesaverde Formation:		
8. Shale, carbonaceous, brownish-gray, tar stains, silty, abundant gypsum crystals up to 4 in; base grades on bentonitic Cody Shale; contains long coal streaks; upper 10 in very carbonaceous	2	4
9. Coal, impure, bony, coal is 50 percent carbonaceous shale interbeds; plant fragments at top; highly weathered, some sulfur		8
10. Shale, light-gray to brown, carbonaceous, silty		8
Total measured thickness of Mesaverde Formation	4	0
Unconformity		
Lower Eocene:		
Indian Meadows Formation:		
11. Sandstone, very light gray to white, very fine to fine-grained, thin-bedded, some crossbeds, yellow coatings of sulfur(?) along rock cracks near base; some coarse granules; several carbonaceous shale zones	35	0
Total measured thickness of Indian Meadows Formation	35	0

Measured section 26a: Cody Shale and Mesaverde Formation

Location: Sand Draw Quadrangle, Wyoming (7.5 min)
Start: NE–NW–NW sec. 27, T. 33 N., R. 95 W. Presented from oldest to youngest
End: NE–SE–SW sec. 22, T. 33 N., R. 95 W. Partial section
Described by: J.F. Windolph, Jr., and F.I. Frasse
Strike 105°, Dip 14° NE.

	Thickness Ft	in
Upper Cretaceous:		
Cody Shale:		
1. Shale, medium-gray, weathered, silty; slightly bentonitic, with a few interbeds of very fine grained sandstone	145	0
2. Sandstone, medium-gray, fine-grained, dark and light mineral grains, animal tracks, possible salt casts, coarse ripple marks		4
3. Shale, medium-gray, weathered, silty, bentonitic	20	0
4. Sandstone, medium-gray, fine-grained, very calcic, thin and evenly bedded, animal tracks		6
5. Shale, medium-gray to light-grayish-brown, thin-bedded, weathered, silty, slightly bentonitic; contains iron-stained concretions up to 1 ft in diameter; sandstone lens 70 ft above base becomes very silty at top; 4 in of thin and evenly bedded sandstone 40 ft above base	130	0
6. Sandstone, medium-gray tomedium-light-olive-gray, very fine grained, silty, dark and light grains, weathered, nonbedded, bentonitic	25	0
7. Shale, light-grayish-brown to medium-gray, silty	99	0
8. Sandstone, medium-gray, very fine grained, silty, 20 percent interbeds of calcareous shale, a few possible animal tracks and pellets	9	0
9. Shale, medium-gray, very silty, thin-bedded; contains few silty sandstone layers up to 1 in thick	44	0
10. Sandstone, light-gray, conglomeratic, pebbles up to 1 inch in diameter, some granitic clasts, massive-bedded; very calcareous in upper 13 ft	40	0
11. Conglomerate, limestone, and chert nodules up to 2 ft in diameter; some limestone boulders up to 4 ft in diameter	45	0
Total measured thickness of Cody Shale	574	10
Mesaverde Formation:		
12. Sandstone, very light gray, very fine to fine-grained; contains few calcareous concretions up to 2 ft in diameter; base covered, friable; 55 ft exposed at base, next 65 ft covered, 50 ft sandstone at top (basal sandstone of Mesaverde)	170	0
13. Shale, medium-gray, silty; contains 2 ft 2 in of very fine grained, silty sandstone 2 ft 5 in above base	6	4
14. Sandstone, medium-light-gray, very fine grained, silty thin-bedded, calcareous	2	0
15. Shale, medium-gray, thin-bedded	3	0
16. Sandstone, medium-light-gray, very fine grained, silty, thin-bedded, calcareous	1	6
17. Shale, medium-gray, thin-bedded; 4-in sandstone 5 ft above base; 6-in sandstone 12 ft above base, very fine to fine, very calcareous; some gypsum crystals; 1-ft, thin-bedded, calcareous sandstone 2 ft above base	80	0
18. Sandstone, medium-light-gray, very fine grained, friable, poorly exposed, slightly bentonitic, massive bedding	152	0
19. Carbonaceous shale	2	0

	Thickness	
	Ft	in
20. Coal, impure, poor quality	1	0
Total measured thickness of Mesaverde Formation	417	10

Measured section 26b: Cody Shale and Mesaverde Formation

Location: Sand Draw Quadrangle, Wyoming (7.5 min)
Start: SE–SW–SW sec. 22, T. 33 N., R. 95 W. Presented from oldest to youngest
End: SW–NE–SE sec. 22, T. 33 N., R. 95 W. Partial section
Described by: J.F. Windolph, Jr., and F.I. Frasse
Strike 105°, Dip 14° NE.

Upper Cretaceous:	Thickness	
Cody Shale:	Ft	in
1. Shale, medium-gray, silty, thin to poorly bedded, slightly bentonitic	50+	
Mesaverde Formation:		
2. Sandstone, light-gray to white, very fine to fine-grained, massive with some crossbedding, iron staining, friable, calcic concretions with pyrite, dark and light grains, partially covered, solution cavities, 60–65 percent quartz	100	0
3. Shale, medium- to dark-gray, slightly bentonitic, few thin interbeds of very fine grained sandstone	5	0
4. Shale, medium-gray to light-grayish-brown, carbonaceous	2	0
5. Shale, dark-grayish-brown, very carbonaceous, fissile	1	5
6. Sandstone, medium- to light-gray, very fine grained, silty, weathered	4	0
7. Siltstone, medium-gray, thin-bedded	1	10
8. Sandstone, medium-gray		2
9. Shale, medium-brown to gray to light-olive-gray, slightly bentonitic, rootlets and plant fragments	27	0
10. Sandstone, medium-gray, very fine to fine-grained, very calcic, well-indurated		2
11. Shale, medium-gray, silty near the top; few thin interbeds, up to 3 in thick, of very fine grained sandstone, medium- to light-gray	24	0
12. Sandstone, medium- to light-gray, fine-grained, less than 50 percent quartz, massive-bedded, solution cavities and pyrite nodules, calcic zones. Basal 10 ft partially covered; 40 ft above base, increased quartz percentage, cross-beds, tree-trunk print, solution cavities, penecontemporaneous slump structures; 65 ft above base, calcareous interbeds up to 6 in thick; becomes more quartzose and less silty and thin bedded toward the top; 110 ft above base, yellow stains with pyrite nodules; finer sands from 140 ft on up; 175 ft above base, calcareous lens up to 2½ ft thick and 6 ft 1 in long; 198 ft above base, 4-ft calcareous siltstone at top of white sandstone	225	0
13. Shale, medium-gray, plant fragments, bentonitic, lies above sandstone and under lower Eocene Wind River Formation	28	0
14. Gravels, nonigneous material, well-rounded, mostly quartz sandstone, chert, few agate and some conglomerate pebbles	12	0
15. Covered	75	0
16. Sandstone, light-gray to white, very fine grained, silty, friable, pyrite nodules up to ¼ inch in diameter, calcareous concretions up to 1 ft in diameter	20	0
17. Covered	75	0
18. Coal, dull to bright, fusain laminations, gypsum on cleat surfaces; 3 ft 5 in below top, ¼-in tonstein; 5 ft 10 in below top, 7-in carbonaceous shale parting	8	11
19. Shale, medium-gray to light-grayish-brown, thin and evenly bedded, some plant fragments	3	2
20. Sandstone, light-gray, very fine grained, silty, shaly, thin-bedded in basal portion	10	0
Total measured thickness of Mesaverde Formation	622	8
Quaternary:		
21. Alluvial fill, covers sandstone below	15+	

Measured section 27: Mesaverde Formation and Indian Meadows Formation

Location: Hudson Quadrangle, Wyoming (7.5 min)
Start: SW–SE–SW sec. 35, T. 1 S., R. 2 E. Presented from oldest to youngest
End: NW–SE–SW sec. 35, T. 1 S., R. 2 E. Partial section
Described by: N.L. Hickling
Strike 320°, Dip 12° NE.

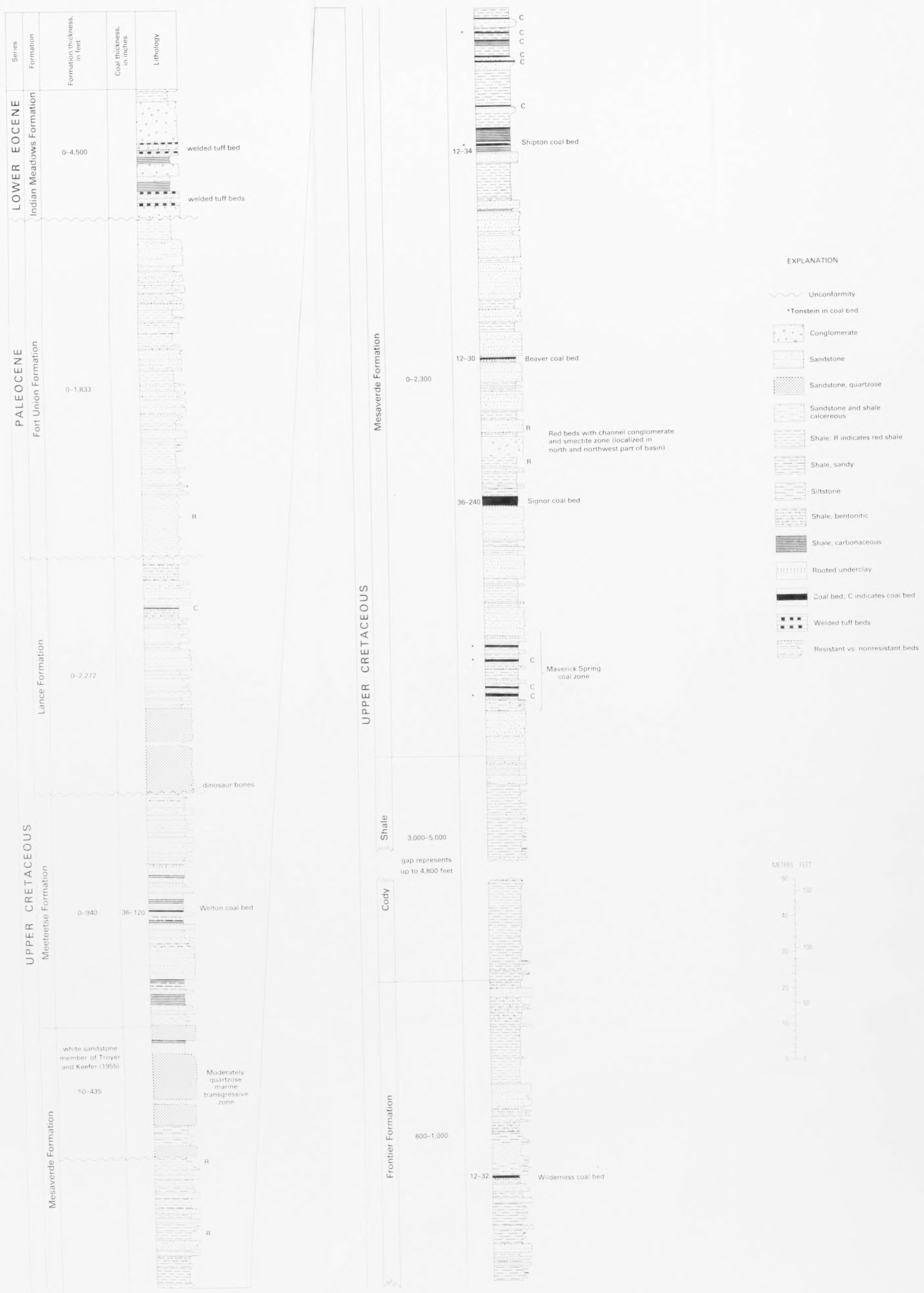
Upper Cretaceous:	Thickness	
Mesaverde Formation:	Ft	in
1. Sandstone, white, very fine to fine-grained, massive	40+	
2. Underclay, medium- to dark-grayish-brown, very carbonaceous, plant fragments		3
3. Coal, mostly bright, medium cleats, scattered rosin	1	2
4. Shale, medium- to dark-grayish-brown, carbonaceous, ledgy	3	0
5. Sandstone, white, very fine to fine-grained, light and dark minerals, massive	8	0
6. Shale, medium- to dark-grayish-brown, carbonaceous, thin and evenly bedded	2	8

	Thickness	
	Ft	in
7. Sandstone, medium-grayish-brown, fine-grained, friable, some silty laminations, some plant fragments	4	2
8. Shale, medium-gray, thin-bedded	4	6
9. Siltstone, medium-gray, iron-stained	1	4
10. Sandstone, light- to medium-grayish-brown, fine- to medium-grained, massive, resistant, scattered iron-rich concretions	9	4
11. Shale, medium-yellowish-gray, thin and irregular beds	3	2
12. Sandstone, medium-gray, fine- to medium-grained, weathered, friable, light and dark mineral grains	2	4
13. Shale, medium-gray, thin-bedded	4	6
14. Siltstone, very resistant, iron-stained		2
15. Shale, medium-gray, thin-bedded	1	0
16. Siltstone, resistant, iron-stained		2
17. Shale, medium-gray, thin-bedded	1	8
18. Underclay, light-gray, sandy, rooted	1	2
19. Shale, carbonaceous, medium- to dark-grayish-brown, plant fragments		4
20. Underclay, medium-grayish-brown, plant fragments, ash(?)		2
21. Coal, dull to bright, weathered impure, small cleats, scattered rosin		8
22. Shale, medium-grayish-brown, carbonaceous	1	6
23. Shale, medium-gray, thin-bedded	1	0
24. Shale, medium- to dark-grayish-brown, carbonaceous		5
25. Underclay, 40 percent coal laminations		3
26. Coal, some fusain, mostly bright; 3-in-thick parting 7 in above base	2	0
27. Underclay, light-gray, sandy, plant fragments		4
28. Shale, medium-gray, thin-bedded	5	4
29. Sandstone, light-grayish-brown, friable, weathered, with light and dark minerals	4	4
30. Shale, medium-gray, thin and irregular bedding	1	0
31. Sandstone, light-grayish-brown, friable, weathered, with light and dark minerals	2	0
32. Shale, medium-gray, thin-bedded	1	6
33. Underclay, dark-grayish-brown, abundant plant fragments		3
34. Coal, impure, very thin, very poor quality, laminated with carbonaceous shale		1
35. Shale, medium- to dark-grayish-brown, carbonaceous		8
36. Coal, mostly bright		2
37. Shale, medium- to dark-grayish-brown, carbonaceous	1	8
38. Shale, medium-gray, very hard, thin-bedded	6	2
39. Sandstone, light- to medium-gray, very fine to fine-grained, light and dark minerals, poorly resistant	10	0
40. Shale, medium-grayish-brown, carbonaceous, thin-bedded	2	0
41. Shale, medium-gray, thin-bedded	1	8
42. Sandstone, medium-grayish-brown, very fine grained, poorly resistant, iron-stained, weathered		10
43. Shale, medium-gray, thin-bedded, plant fragments in upper 10 in	2	0
44. Sandstone, medium-grayish-brown, very fine grained, poorly resistant, iron-stained, weathered	1	0
45. Shale, medium-gray		10
46. Sandstone, medium-grayish-brown, very fine grained, poorly resistant, iron-stained, weathered	1	4
47. Shale, medium-gray, thin and irregular bedding	5	5
48. Sandstone, medium-grayish-brown, very fine grained, poorly resistant, iron-stained, weathered		10
49. Shale, medium-gray, thin and irregular bedding	5	4
50. Sandstone, medium-grayish-brown, very fine grained, lower half thick-bedded, upper half massive; iron stained, resistant; several 4-in- to 1-ft-thick shale breaks	60	0
51. Sandstone, friable, nonresistant, covered by washed out conglomerate above	10	0
Total measured thickness of Mesaverde Formation	219	8
Unconformity		
Lower Eocene:		
Indian Meadows Formation:		
52. Conglomerate	6+	

*U.S. G.P.O. 1989-242-338:80061

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

BULLETIN 1813
PLATE 1


Series
Formation
Formation thickness, in feet
Coal thickness, in inches
Lithology
LOWER EOCENE
Indian Meadows Formation
0–4,500
welded tuff bed
welded tuff beds
PALEOCENE
Fort Union Formation
0–1,833
R
C
Lance Formation
0–2,272
dinosaur bones
UPPER CRETACEOUS
Meeteetse Formation
0–940
36–120
Welton coal bed
white sandstone member of Troyer and Keefer (1955)
50–435
Moderately quartzose marine transgressive zone
Mesaverde Formation
R
R
C
C
C
C
C
C
12–34
Shipton coal bed
Mesaverde Formation
0–2,300
12–30
Beaver coal bed
R
Red beds with channel conglomerate and smectite zone (localized in north and northwest part of basin)
R
36–240
Signor coal bed
UPPER CRETACEOUS
C
Maverick Spring coal zone
C
C
Shale
3,000–5,000
gap represents up to 4,800 feet
Cody
Frontier Formation
600–1,000
12–32
Wilderness coal bed
EXPLANATION
Unconformity
*Tonstein in coal bed
Conglomerate
Sandstone
Sandstone, quartzose
Sandstone and shale calcereous
Shale; R indicates red shale
Shale, sandy
Siltstone
Shale, bentonitic
Shale, carbonaceous
Rooted underclay
Coal bed; C indicates coal bed
Welded tuff beds
Resistant vs. nonresistant beds
METERS
FEET
50
40
30
20
10
0
150
100
50
0

GENERALIZED STRATIGRAPHIC SECTION OF LOWER EOCENE, PALEOCENE, AND UPPER CRETACEOUS COAL-BEARING ROCKS OF THE WESTERN PART OF THE WIND RIVER BASIN, WYOMING

I 19.3:1813